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KEY TO THE MALES OF NEARCTIC *DOLICHOPUS* LATREILLE (DIPTERA)

By M. C. VAN DUZEE AND C. H. CURRAN

Since the monograph of the genus *Dolichopus* by Van Duzee, Cole, and Aldrich in 1921 (Bull. 116, U. S. Nat. Mus.), a large number of species have been added to the North American fauna and at the present time the identification of species is rather difficult. The receipt of a copy of Mr. Van Duzee's manuscript key prompted the junior author to request permission to publish it after making certain alterations in style and a few other changes which eliminated a certain amount of duplication, and also crediting the species described in the above-mentioned "Bulletin" to Van Duzee.

It might be well to state here the reasons for this action, inasmuch as some workers still credit the species to the three authors. Without regard to the feelings of the authors as to credit for the species described we must accept the statement contained in the introduction, written by Dr. Aldrich. On page 7 Aldrich states: "At length I hit upon the idea of a joint paper, Mr. Van Duzee to prepare the text except the introduction, and Mr. Cole the figures." This course was carried out and as a result Mr. Van Duzee was entirely responsible for the systematic work and is alone to be credited with the new species described.

Descriptions of two new species have been prepared by the junior author. The types are in The American Museum of Natural History.

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GROUP C

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multisetosus Van Duzee.
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myosota Osten Sacken.
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GROUP D

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Middle and hind femora each with one preapical bristle (Labrador; Quebec).
bryanti Van Duzee.

- 85.—Costa with a knot-like enlargement at tip of first vein; front tarsi ornamented (Alaska).....*solidus* Van Duzee.
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partitus Melander and Brues.
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Hind tibiae mostly black (New York).....*burnesi* Van Duzee.
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GROUP E

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- 113.—Hypopygial lamellae mostly white; hind femora wholly yellow (North West
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GROUP F

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130.—Hind tarsi wholly black or nearly so. 131.
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131.—Hind femora without cilia below. 132.
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Front tarsi more or less widened or compressed. 133.

133.—Front tarsi twice as long as their tibiae; hind tibiae with a bare space on inner
side, extending from the base to the middle (Hudson Bay Territory;
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slightly widened (Ontario; Saskatchewan; North and South Dakota).
canadensis Van Duzee.

134.—None of the segments of front tarsi compressed, but last four segments a little
narrowed at base (Maine; New York; Labrador). *serratus* Van Duzee.
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states). *palaesticus* Loew.
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136.—Front tarsi twice as long as their tibiae. 137.
Front tarsi one and a half times as long as their tibiae. 138.

137.—Antennae wholly black, cilia of hind femora rather scattering, extending their
whole length (Hudson Bay Territory). *subciliatus* Loew.
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amplipennis Van Duzee.

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splendidulus Loew.
Costa with an elongated enlargement at tip of first vein (eastern states).
splendidus Loew.

139.—Front tarsi with fifth segment compressed. 140.
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140.—Front tarsi dark yellow with fifth segment only a little compressed (Newfound-
land). *bolsteri* Van Duzee.
Fourth and fifth segments of front tarsi compressed, the fourth white, the fifth
black. 141.

141.—Fourth segment of front tarsi distinctly less than half as long as fifth; hind
tibiae considerably thickened in the middle (eastern states).
batillifer Loew.
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142.—Third segment of front tarsi a little compressed, white; hind tibiae a little
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Third segment of front tarsi normal, not or scarcely widened, yellow. 143.

143.—Hind femora without cilia (eastern states). *tonsus* Loew.
Hind femora ciliated on lower inner edge. 144.

- 144.—Third segment of front tarsi almost twice as long as the fourth or fifth; anterior coxae with large green basal spot (New York).....*laciniatus* Coquillett.
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- 145.—Third and fourth segments of front tarsi of nearly equal length, the fifth a little shorter, sometimes last three segments of nearly equal length; hind tibiae scarcely thickened (eastern states).....*eudactylus* Loew.
Third and fifth segments of front tarsi of nearly equal length, the fourth a little shorter; hind tibiae considerably thickened (Indiana; Kansas; Ontario).
versutus Van Duzee.
- 146.—Second abdominal segment with a tuft of long yellow hairs on the sides and a shorter and small tuft on third segment (California; Utah; New Mexico).
afflictus Osten Sacken.
Abdomen without such tufts of hair.....147.
- 147.—First antennal segment long, thick, densely hairy (western).
crenatus Osten Sacken.
First antennal segment normal, enlargement at tip of first vein as long as cross-vein (Idaho; California; Oregon).....*idahoensis* Aldrich.
- 148.—Last segment of front tarsi compressed (Illinois; New York; Wisconsin).
tener Loew.
Front tarsi plain.....149.
- 149.—Hind femora without cilia below.....150.
Hind femora ciliated on lower inner surface.....151.
- 150.—First two antennal segments yellow, third black (Colorado).
celeripes Van Duzee.
Antennae wholly yellow (North Carolina).....*tenuimanus* Van Duzee.
- 151.—Longest hairs that form the cilia on hind femora not three-fourths as long as width of femora; hind tarsi mostly yellow (Virginia)...*greeni* Van Duzee.
Longest hairs of the cilia on hind femora fully as long or longer than width of femora; hind tarsi wholly black.....152.
- 152.—Front tarsi yellow with fifth segment black (eastern states; Canada).
luteipennis Loew.
Front tarsi blackened from tip of first segment (widespread). *variabilis* Loew.

GROUP G

- 153.—First antennal segment black, at least on upper edge.....154.
First antennal segment wholly yellow.....210.
- 154.—Hind femora blackened at apex, at least above.....155.
Hind femora not at all blackened apically.....172.
- 155.—Upper edge of front femora narrowly blackened above (Alberta).
nigri-lineatus Van Duzee.
Front femora not blackened on upper edge.....156.
- 156.—Middle tibiae with very long slender bristles, the first segment of their tarsi with very long hairs; segments of front tarsi a little compressed (North America).....*comatus* Loew.
Middle legs without unusually long hair or bristles.....157.
- 157.—Front tarsi with one or more segments compressed.....158.
Front tarsi plain.....162.

- 158.—Hind femora ciliated below.....159.
Hind femora without cilia.....160.
- 159.—Front coxae yellow (Alaska).....*braycnemus* Coquillett.
Front coxae wholly black (British Columbia).....*nigricoxa* Van Duzee.
- 160.—Front tarsi black from the tip of first segment (Colorado).....*elegans* Aldrich.
Front tarsi with at least first two segments yellow.....161.
- 161.—Front tarsi black from middle of third segment, first three segments very slender,
last two forming an oval, broadly fringed tip to tarsi (Maine; Massachusetts; New Jersey).....*virga* Coquillett.
First two segments of front tarsi yellow, last three black, last two segments distinctly flattened, a little widened laterally, but not fringed; hind femora and tibiae each blackened on apical third (New York).
abruptus Aldrich.
- 162.—Front coxae yellow, sometimes considerably blackened at base on outer surface.....163.
Front coxae blackish almost to their tips.....168.
- 163.—Hind femora ciliated with long hairs on lower posterior edge.....164.
Hind femora without cilia.....165.
- 164.—Hind femora with one preapical bristle, their cilia long and delicate; anal angle of wing nearly obsolete (New Hampshire; Maine).....*obsoletus* Van Duzee.
Hind femora each with two or three preapical bristles, their cilia stout, scarcely as long as width of femora; anal angle of wing prominent (New York; Massachusetts; New Brunswick).....*trisetosus* Van Duzee.
- 165.—Face ochreous or grayish yellow; hypopygial lamellae about as long as wide (Wisconsin; Michigan).....*apheles* Melander and Brues.
Face silvery white.....166.
- 166.—Hypopygial lamellae triangular with a sharp point at one corner, very narrowly bordered with black; wings wholly grayish (Maine; Newfoundland).
genualis Van Duzee.
Hypopygial lamellae somewhat oval, a little longer than wide, with a black border; wings tinged with brown in front of third vein.....167.
- 167.—Costa not thickened at tip of first vein (New York; Wisconsin; Ontario).
discolor Van Duzee.
Costa much thickened at tip of first vein (Alaska).....*simplicipes* Aldrich.
- 168.—Wings more or less clouded with brown.....169.
Wings wholly grayish hyaline, or nearly so.....170.
- 169.—Apical portion of wing with a conspicuous blackish spot; front femora darker on upper surface (Illinois).....*praeustus* Loew.
Costal margin of wing brownish, darker in front of second vein; front femora brownish on upper edge (Washington).....*affluens* Van Duzee.
- 170.—Third antennal segment nearly twice as long as wide, arista near its tip (Alaska).
crassicornis Aldrich.
Third antennal segment only a little longer than wide, arista inserted near the middle of its upper edge.....171.
- 171.—Bend in last section of fourth vein small, but not unusually so; third vein bent backward at tip (eastern states).....*sincerus* Melander.
Last section of fourth vein only slightly bent, third vein only a very little bent back at tip (eastern states).....*sincerus subdirectus* Van Duzee.

- 172.—Front purple, blue or violet.....173.
 Front green or bronze color.....180.
- 173.—Last segment of front tarsi compressed and widened.....174.
 Front tarsi plain.....176.
- 174.—Front tarsi with fifth segment large, as wide as long, black, first four segments yellow (Massachusetts; New Hampshire; New York).
parphyrops Van Duzee.
 Front tarsi black from tip of first segment; fifth segment rather small, about half as wide as long (Alaska).....*frontalis* Van Duzee.
- 175.—Omitted.
- 176.—Last section of fourth vein with a stump-vein at the bend (North America).
ramifer Loew.
 Last section of the fourth vein moderately bent, without a stump-vein at bend.....177.
- 177.—Hind femora ciliated with long pale hairs below.....178.
 Hind femora ciliated with long black hairs below.....179.
- 178.—Cilia of hind femora nearly twice as long as width of femora (eastern states).
setosus Loew.
 Cilia of hind femora three-fourths as long as width of femora (Quebec) (*breviciliatus* Van Duzee, 1933, not 1930).....*brevipilosus* Van Duzee.
- 179.—Antennae wholly black (widespread).....*renidescens* Melander and Brues.
 First two antennal segments broadly yellow below, usually with upper edge black (eastern states).....*marginatus* Aldrich.
- 180.—Hypopygium short with small yellow lamellae.....181.
 Hypopygium of normal size.....182.
- 181.—Antennae wholly black (New York).....*cuniculus* Van Duzee.
 First antennal segment conspicuously yellow below (Maine; Labrador).
abbreviatus Van Duzee.
- 182.—Hind femora ciliated on lower inner edge.....183.
 Hind femora without cilia.....193.
- 183.—Front tarsi ornamented.....184.
 Front tarsi plain.....188.
- 184.—Front coxae yellow (Canada; Europe).....*plumilarsis* Fallén.
 Front coxae black.....185.
- 185.—Fifth segment of front tarsi emarginate at apex.....186.
 Fifth segment of front tarsi not notched at apex.....187.
- 186.—Fifth segment of front tarsi notched at tip so as to form two nearly equal lobes (western states; British Columbia).....*obcordatus* Aldrich.
 Fifth segment of front tarsi with its tip divided into two very unequal lobes (California; Utah).....*pollex* Osten Sacken.
- 187.—Fifth segment of front tarsi somewhat oval, but cut off nearly straight at tip (British Columbia).....*integripes* Parent.
 Fifth segment of front tarsi somewhat triangular, about as long as width of tip (British Columbia).....*nigricoxa* Van Duzee.
- 188.—Antennae wholly black; face yellowish.....189.
 First antennal segment distinctly yellow below.....190.

- 189.—Front coxae with conspicuous black hair on anterior surface; third antennal segment a little longer than wide, rather rounded at tip (Massachusetts; Ontario; Newfoundland) *melanocerus* Loew.
 Front coxae with delicate yellow hairs; third antennal segment twice as long as wide, pointed at tip (eastern) *pantomimus* Melander and Bruce.
- 190.—Cilia of hind femora about three-fourths as long as width of femora (New York; Indiana; Ontario) *incisuralis* Loew.
 Cilia of hind femora as long or longer than width of femora 191.
- 191.—Costa with a knot-like enlargement at tip of first vein; hypopygial lamellae about as long as wide, somewhat orbicular (Massachusetts; New York; Ontario) *setosus* Loew.
 Costa enlarged at tip of first vein, gradually tapering to tip; hypopygial lamellae distinctly longer than wide 192.
- 192.—Basal segment of middle tarsi with a large bristle above; hypopygial lamellae oval, rounded at tip; segments of front tarsi normal, (Illinois).
decorus Van Duzee.
 Basal segment of middle tarsi without a bristle above; lamellae subquadrate, truncate at tip; second, third, and fourth segments of front tarsi narrowed at base (Maine) *serratus* Van Duzee.
- 193.—Third antennal segment twice as long as wide 194.
 Third antennal segment not over one and one-half times as long as wide . . 195.
- 194.—Costa without an enlargement at tip of first vein (Ontario) . . *sicarius* Van Duzee.
 Costa enlarged at tip of first vein, tapering to its tip (Manitoba).
simulans Van Duzee.
- 195.—Front tarsi ornamented 196.
 Front tarsi plain 201.
- 196.—Fifth segment of front tarsi only a little compressed, small (Ontario).
canadensis Van Duzee.
 Fifth segment of anterior tarsi distinctly compressed and considerably widened 197.
- 197.—Third segment of front tarsi nearly half, or more than half as long as first . . 198.
 Third segment of front tarsi less than one-third as long as first 199.
- 198.—Anterior coxae wholly black (British Columbia) *nigricoxa* Van Duzee.
 Anterior coxae yellow with a blackish spot on outer surface at base; second and third segments of front tarsi of nearly equal length and yellow (western).
pernix Melander and Bruce.
- 199.—Fourth and fifth segments forming an oval tip to the anterior tarsi (eastern states) *virga* Coquillett.
 The oval tip to front tarsi formed of the fifth segment only, which is as long as or longer than third 200.
- 200.—Fifth segment of front tarsi more than one and one-half times as long as second (Colorado; New Mexico) *speciosus* Van Duzee.
 Fifth segment of front tarsi about three-fourths as long as second (Saskatchewan) *frontalis* Van Duzee.
- 201.—Anterior coxae wholly yellow or with a small blackish spot at the base externally 205.
 Anterior coxae with a black stripe on their outer surface or black on more than the basal half 202.

- 202.—Anterior coxae black on more than the basal half.....203.
 Anterior coxae yellowish in front, with a black or green stripe on the outer surface.....204.
- 203.—Anterior coxae black, narrowly yellow at tip; all femora wholly yellow (Manitoba).....*robertsoni* Curran.
 Anterior coxae wholly, and base of their femora narrowly, black (western).
amnicola Melander and Brues.
- 204.—Last four segments of front tarsi a little compressed, black (western mountain region).....*aldrichii* Wheeler.
 All tarsi plain, normal (widely distributed).....*penicillatus* Van Duzee.
- 205.—Middle tarsi wholly black (New Hampshire; Labrador)..*dasypodus* Coquillett.
 Middle tarsi with the first segment mostly yellow.....206.
- 206.—Basal segment of hind tarsi yellow with a black tip; hind margin of wing notched at tip of fifth vein (North Carolina).....*carolinensis* Van Duzee.
 Hind tarsi wholly black, at most slightly yellow at extreme base.....207.
- 207.—Anterior tarsi black from the tip of first segment (eastern)..*defectus* Van Duzee.
 Anterior tarsi with first two segments yellow, sometimes wholly yellow....208.
- 208.—Arista nearly subapical; hypopygial lamellae large, twice as long as wide (Massachusetts).....*acutus* Van Duzee.
 Arista inserted near the middle of third antennal segment; hypopygial lamellae moderately small, one and one-half times as long as wide.....209.
- 209.—Hypopygial lamellae rather small, with about six rather short hairs on upper edge; front tarsi wholly yellow (New York; Vermont).
idoneus Van Duzee.
 Hypopygial lamellae moderately large, without hairs on upper edge, except those on the rounded apical margin; last three segments of front tarsi black (Canada; Wyoming).....*canadensis* Van Duzee.
- 210.—Arista enlarged at tip; wings with a lobe at tip of sixth vein.....211.
 Arista plain.....213.
- 211.—Middle tibiae silvery white on upper edge, with a black line above, which is concealed by the silvery pollen when viewed obliquely and does not reach the base (Colorado). Arista missing in type, so may not go here.
nigriapicalis Van Duzee.
 Middle tibiae with a more or less conspicuous brownish ring near apical third, beyond which on upper edge is a shining or whitish spot or streak....212.
- 212.—Hypopygial lamellae large; hind margin of wing with a deep sinus before the lobe at sixth vein (Pacific Coast).....*hastatus* Loew.
 Hypopygial lamellae small; hind margin of wing normal, except for the lobe at the tip of the sixth vein (California).....*comptus* Van Duzee.
- 213.—Anterior tarsi ornamented.....214.
 Anterior tarsi plain.....221.
- 214.—Front and dorsum of thorax thickly pollinose; bend in last section of fourth vein with two right angles and a stump-vein at lower bend (widespread).
bifractus Loew.
 Front shining; last section of fourth vein without a stump-vein at its bend, which is more or less rounded.....215.
- 215.—Third antennal segment wholly black.....216.
 Third antennal segment largely yellow, at least yellow at base.....218.

- 216.—Fifth segment of front tarsi large, nearly orbicular, twice as long as third and fourth taken together (eastern North America)... *flagellitenens* Wheeler.
Fifth segment of front tarsi moderately large, as long as or a little longer than third and fourth segments taken together. 217.
- 217.—Anterior tarsi infuscated almost to their base, second segment short, about half as long as first; third and fourth together about as long as fifth; hind tibiae narrowly but sharply black at tip (Colorado; New Mexico).
speciosus Van Duzee.
Anterior tarsi with first two segments yellow, the third and fourth together three-fourths as long as fifth; hind tibiae blackened for more than one-third their length at tip, the black shading into the yellow (Montana; Colorado; Utah)..... *blandus* Van Duzee.
- 218.—Front green; hind tibiae black at tip, gradually becoming yellow, still largely infuscated; front tarsi with fifth segment only a little widened (New York).
abrasus Van Duzee.
Front violet, rarely greenish; front tarsi with fifth segment considerably widened; hind tibiae narrowly but sharply black at tip, at least on inner side. 219.
- 219.—Hind tibiae scarcely blackened on anterior surface at tip, distinctly so on posterior side; tip of front tibiae slightly infuscated and with a few flattened bristles or scales at extreme tip (eastern North America) . *pugil* Loew.
Hind tibiae sharply and conspicuously black at tip... 220.
- 220.—Face silvery white; front violet (eastern North America)... *vigilans* Aldrich.
Face brownish yellow; front dull greenish (Colorado)... *parvimanus* Van Duzee.
- 221.—Basal segment of middle tarsi laterally fringed (widespread)... *plumipes* Scopoli.
Middle tarsi plain..... 222.
- 222.—Hind femora ciliated below..... 223.
Hind femora without cilia... 225.
- 223.—Cilia of hind femora long, pale yellow (northern North America).
luteipennis Loew.
Cilia of hind femora black; front usually blue or violet. 224
- 224.—Last section of fourth vein bent at a right angle with a stump-vein at bend; hypopygial lamellae somewhat triangular, fringed with short hairs (eastern states) *reflectus* Aldrich.
Last section of fourth vein moderately bent, without a stump-vein; hypopygial lamellae somewhat orbicular, fringed with very long hairs (eastern states).
marginatus Aldrich.
- 225.—Antennae yellow, third segment partly yellow..... 226.
Third antennal segment wholly black, the second sometimes black..... 227.
- 226.—Middle tibiae silvery white above, with a black line, which does not reach the base and is wholly concealed by the silvery pollen when viewed obliquely; hind tibiae sharply black at tip (Colorado).... *nigripicalis* Van Duzee.
Middle tibiae wholly yellow, without silvery pollen or black line; hind tibia mostly blackish, the black shading into the yellow (New York).
abrasus Van Duzee.

- 227.—First antennal segment wholly yellow, second black at tip, third wholly black; middle tibiae wholly yellow as usual; hind tibiae only a little infuscated at tip (New Mexico).....*dorsalis* Van Duzee.
 First antennal segment yellow, slightly darker above, second and third wholly black; middle tibiae with an opalescent spot near tip and extending nearly one-fourth their length; hind tibiae deep black on apical sixth (Alaska).
uzorcula Van Duzee.

GROUP H

- 228.—First antennal segment wholly yellow.....229.
 Antennae black, first segment may be yellow with upper edge narrowly black.....253.
 229.—Arista enlarged at tip; wings with a conspicuous lobe at tip of sixth vein..230.
 Arista plain.....231.
 230.—Hypopygial lamellae large; hind margin of wing with a deep sinus before the lobe (Washington; California; Alaska; British Columbia).
hastatus Loew.
 Hypopygial lamellae small; hind margin of wing normal, except for the lobe at tip of sixth vein (California).....*comptus* Van Duzee.
 231.—Front tarsi ornamented.....232.
 Front tarsi plain.....246.
 232.—Hind femora ciliated below; tip of front tibiae a little enlarged, slightly blackened, with a few flattened bristles on apical edge (eastern North America).
pugil Loew.
 Not with the above combination of characters.....233.
 233.—Hind coxae yellow; front and dorsum of thorax thickly pollinose, nearly opaque; bend in last section of fourth vein with a stump-vein (widespread).
bifractus Loew.
 Hind coxae mostly black; front and dorsum of thorax shining.....234.
 234.—Wings with a projecting lobe at tip of sixth vein.....235.
 Wings without or with scarcely a trace of such a lobe.....240.
 235.—Lobe at tip of sixth vein large and prominent.....236.
 Lobe at tip of sixth vein small, but distinct.....237.
 236.—Hypopygial lamellae with apical margin evenly rounded; costa not enlarged at tip of first vein (widespread).....*lobatus* Loew.
 Apical margin of the lamellae emarginate; costa enlarged at tip of first vein, tapering to its tip (widespread).....*omnivagus* Van Duzee.
 237.—First and second segments of front tarsi of about equal length (Colorado; Wyoming).....*aeratus* Van Duzee.
 Second segment of front tarsi distinctly shorter than first.....238.
 238.—Third segment of anterior tarsi not over one-third as long as the second..239.
 Third segment of anterior tarsi about half as long as the second (Colorado; Ontario).....*coloradensis* Aldrich.
 239.—Third segment of front tarsi less than one-third as long as second (California).
completus Van Duzee.
 Third segment of front tarsi one-third as long as second (Wisconsin; Colorado).
amphericus Melander and Brues.

- 240.—Second segment of front tarsi shorter, or at most scarcely longer than the two following segments taken together.....241.
 Second segment of front tarsi distinctly longer than the two following segments taken together.....243.
- 241.—Second antennal segment yellow (Washington).....*plumosus* Aldrich.
 Second antennal segment black.....242.
- 242.—Third segment of front tarsi yellow, fifth segment nearly as wide as long (Colorado; Idaho; Washington).....*sufflavus* Van Duzee.
 Third segment of front tarsi blackish, fifth segment about half as wide as long (Colorado; New Mexico).....*speciosus* Van Duzee.
- 243.—Third segment of front tarsi more than half as long as second, usually infuscated at tip (Wisconsin; Colorado).....*amphericus* Melander and Brues.
 Third segment of front tarsi scarcely half as long as second, wholly yellow..244.
- 244.—Second segment of front tarsi not more than two-thirds as long as the first..245.
 Second segment of front tarsi almost as long as the first (Colorado; Wyoming).
aeratus Van Duzee.
- 245.—Second segment of front tarsi two-thirds as long as first (Wisconsin; Colorado).
amphericus Melander and Brues.
 Second segment of front tarsi scarcely half as long as first (Idaho; Washington).
sufflavus Van Duzee.
- 246.—Basal segment of middle tarsi fringed with black hairs on both sides...247.
 Basal segment of middle tarsi plain.....248.
- 247.—Middle tibiae nearly twice as long as their femora (New Hampshire; Massachusetts).....*wheeleri* Melander and Brues.
 Middle tibiae not over one and one-fourth times as long as their femora (Europe; North America).....*plumipes* Scopoli.
- 248.—Hind femora ciliated below.....249.
 Hind femora without cilia.....250.
- 249.—Hind femora ciliated with black hairs; front violet (eastern states).
marginatus Aldrich.
 Hind femora ciliated with long whitish hairs on lower posterior edge; front green (eastern North America).....*gracilis* Aldrich.
- 250.—Hind margin of wing with a conspicuous sinus between the tips of fifth and sixth veins.....252.
 Hind margin of wing nearly evenly rounded.....251.
- 251.—Hypopygium rudimentary, the lamellae not developed; hind tibiae wholly yellow (Illinois).....*imperfectus* Van Duzee.
 Hypopygium normal, its lamellae rather large; hind tibiae slightly infuscated at tip (New Mexico; Arizona).....*dorsalis* Van Duzee.
- 252.—Middle tarsi yellow at base, first segment without a bristle above; middle tibiae with an opalescent spot at tip (eastern states)....*fulvipes* Loew.
 Middle tarsi wholly black, first segment with three bristles above (White Mountains). (This may be *dasypodus* Coquillett)....*evolvens* Parent.
- 253.—Basal segment of middle tarsi wholly deep black, first segment thickened about as in hind tarsi, and with several bristles above (New Hampshire; Labrador; Quebec).....*dasypodus* Coquillett.
 Basal segment of middle tarsi mostly yellow.....254.

- 269.—Hind femora without cilia below.....270.
 Hind femora ciliated on lower surface.....273.
- 270.—Middle tibiae with a row of very long bristles, the basal segment of their tarsi also with a row of very long hairs (widespread).....*comatus* Loew.
 Middle legs with their bristles and hair of normal length.....271.
- 271.—Tips of hind femora black; front violet (widespread).....*sincerus* Melander.
 Tips of hind femora not or scarcely infuscated; front green.....272.
- 272.—Second antennal segment wholly yellow; metallic color of mesonotum dulled with thick yellowish-gray pollen (New Mexico).....*dorsalis* Van Duzee.
 Second antennal segment wholly black; mesonotum shining (Canada; Wyoming).....*canadensis* Van Duzee.
- 273.—Front green (New York; New Jersey; North Dakota).....*incisuralis* Loew.
 Front blue or violet.....274.
- 274.—All coxae yellow, the middle pair a little blackened on outer surface (Wisconsin).
 flavicoxa Van Duzee.
 Middle and hind coxae black with yellow tips.....275.
- 275.—Antennae wholly black (widespread).....*remidescens* Melander and Brues.
 First two antennal segments yellow, usually with a black line above (eastern states).....*marginatus* Aldrich.

GROUP I

- 276.—Antennae black, first and second segments may be yellow below.....277.
 First antennal segment wholly yellow.....304.
- 277.—Antennae wholly black.....278.
 First antennal segment yellow below.....280.
- 278.—Front dark violet (California; New Mexico; British Columbia)..*bakeri* Cole.
 Front green or blue-green.....279.
- 279.—Wings with anal angle prominent; front coxae with black hairs on anterior surface (eastern states; Ontario).....*chrysostoma* Loew.
 Wings with anal angle nearly obsolete, front coxae with white hairs on anterior surface (Ontario).....*parvicornis* Van Duzee.
- 280.—Third antennal segment twice as long as wide.....281.
 Third antennal segment not much longer than wide, at most not over one and one-half times as long as wide.....282.
- 281.—Face silvery white; first antennal segment with lower half yellow (Ontario).
 sicarius Van Duzee.
 Face yellow; first antennal segment only slightly yellow below (eastern states; Ontario).....*chrysostoma* Loew.
- 282.—Front tarsi ornamented.....283.
 Front tarsi plain.....291.
- 283.—Fifth segment of front tarsi not or but little flattened, fringed laterally...284.
 Fifth segment of front tarsi compressed, fringed above with very minute hairs.....285.
- 284.—Hypopygial lamellae formed of two large lobes, united at base, so as to appear like two pairs of lamellae (eastern states; Canada).
 quadrilamellatus Loew.
 Hypopygial lamellae dark yellow, thick, bare (eastern states; Canada).
 scoparius Loew.

- 285.—Hind femora ciliated below; front tarsi with fourth segment white, fifth black, (Pennsylvania; New York; Ontario).....*laciniatus* Coquillett.
Hind femora without cilia below.....286.
- 286.—First and second segments of front tarsi of equal length.....287.
Second segment of front tarsi not much over two-thirds as long as first..288.
- 287.—Front tarsi with third segment longer than second (western).
canaliculatus Thomson.
Front tarsi with third segment shorter than second (Wyoming; Colorado).
aeratus Van Duzee.
- 288.—Fifth segment of front tarsi only a little enlarged (western states).
coquilletti Aldrich.
Fifth segment of front tarsi much compressed and widened.....289.
- 289.—Fifth segment of front tarsi only about one-fourth as long as fourth (widespread).
nigricornis Meigen.
Fifth segment of front tarsi much longer than fourth.....290.
- 290.—Second segment of front tarsi one and one-half times as long as third (California).....*talus* Van Duzee.
Second segment of front tarsi two and one-half times as long as third (British Columbia).....*reticulus* Van Duzee.
- 291.—Hind femora with a single preapical bristle.....292.
The usual preapical bristles ending a row of bristles of increasing length; outer posterior edge of front coxae with a green or blackish streak, sometimes the front coxae almost wholly green.....301.
- 292.—First antennal segment long and thick; cilia of the calypters unusually long (widespread).....*penicillatus* Van Duzee.
Antennae normal.....293.
- 293.—Front violet (Wyoming).....*perplexus* Van Duzee.
Front green.....294.
- 294.—Wings with a blackish cloud in front (north eastern states).
harbecki Van Duzee.
Wings without blackish cloud.....295.
- 295.—First antennal segment yellow with upper edge black.....296.
First antennal segment black, yellow below, sometimes with lower half yellow.....298.
- 296.—Hind tibiae with a blackish spot on posterior side at tip, on which the hairs are longer and denser (North Carolina).....*carolinensis* Van Duzee.
Hind tibiae not or scarcely darker on posterior side at tip.....297.
- 297.—Anal angle of wing evenly rounded (Labrador).....*latronis* Van Duzee.
Anal angle of wing somewhat bilobed (Virginia; Connecticut; New York; New Hampshire) (*lobipennis* Van Duzee).....*virginiensis* Van Duzee.
- 298.—Face silvery white.....299.
Face golden yellow, at least distinctly yellowish... 300.
- 299.—Anal angle of wing nearly obsolete (Ontario).....*parvicornis* Van Duzee.
Anal angle of wing prominent (Labrador).....*latronis* Van Duzee.

- 300.—Anal angle of wing extending conspicuously toward the root of the wing, somewhat bilobed; front tarsi scarcely infuscated, even at tip (Virginia; Connecticut; New York; New Hampshire) (*lobipennis* Van Duzee).
virginiensis Van Duzee.
 Angle of wing extending but little toward root of wing, not lobed; all tarsi sharply black from tip of first segment (New England; New York).
slossonae Van Duzee.
- 301.—Last four segments of middle tarsi compressed (western) . . . *aldrichii* Wheeler.
 Middle tarsi plain as usual. 302.
- 302.—First antennal segment normal in size and with short hairs (California; Oregon) *cavatus* Van Duzee.
 First antennal segment long, with long bushy hair. 303.
- 303.—First two antennal segments broadly yellow below; lower 4-6 orbital cilia orange yellow (western) *consanguineus* Wheeler.
 Second antennal segment wholly black or nearly so; lower half of the orbital cilia pale yellow (western) *aurifex* Van Duzee.
- 304.—Front tarsi ornamented. 305.
 Front tarsi plain. 331.
- 305.—Front tarsi with fifth segment only slightly enlarged; hind femora ciliated below. 306.
 Ornamentation of front tarsi conspicuous. 307.
- 306.—Fifth segment of front tarsi wholly black, preceding segments wholly yellow (eastern North America) *terminalis* Loew.
 Anterior tarsi infuscated from tip of first segment, with the fifth segment pale yellowish, except at base (New York; New Jersey).
domesticus Van Duzee.
- 307.—Hind femora ciliated below. 308.
 Hind femora without cilia. 317.
- 308.—Hind coxae infuscated on basal half, at least with a large blackish spot at base on outer surface. 309.
 Hind coxae wholly yellow, or nearly so. 311.
- 309.—First three segments of front tarsi of nearly equal length, third being a little the longest (western) *canaliculatus* Thomson.
 Second segment of front tarsi longer than first, third very much shorter . . . 310.
- 310.—Hypopygial lamellae truncate at apex, with a short but rather acute point at upper corner (California; Oregon) *grandis* Aldrich.
 Hypopygial lamellae with a long, acute point in the center of apical margin (California) *superbus* Van Duzee.
- 311.—Humeri at least yellow below, usually mostly or wholly yellow; fifth segment of front tarsi white. 312.
 Humeri metallic, wholly without yellow. 313.
- 312.—Cilia of hind femora very short, not over one-fifth as long as width of femora; second segment of front tarsi about equal in length to fourth and fifth together (Louisiana; New Jersey) *distinctus* Van Duzee.
 Cilia of hind femora at least half as long as width of femora; second segment of front tarsi about equal to fifth (eastern) *funditor* Loew.

- 341.—Costa a little thickened at tip of first vein; face golden yellow (Kansas; Tennessee).....*aurifacies* Aldrich.
Costa with a conspicuous, elongated enlargement at tip of first vein; face silvery white, a little yellowish above.....342.
342.—Hypopygium very small, its lamellae not developed (Illinois).
imperfectus Van Duzee.
Hypopygium and its lamellae normal.....*vittatus* Loew.

Dolichopus kleini, new species (Curran)

A small species related to *recticosta* Aldrich but with less extensively black posterior tibiae, more broadly black bordered genital lamellae, etc. Legs black, the tibiae and bases of the anterior four tarsi yellow. Length, 4 mm.

MALE.—Front green, in some lights yellowish-brown pollinose. Occiput green, yellowish-brown pollinose above, whitish below, the lower orbital cilia white, only the lower one somewhat squamose. Face shining white, of moderate width. Palpi brownish yellow, with black hairs. Antennae black, the third segment moderately large, one-half longer than wide, somewhat pointed apically, the arista arising near the middle.

Thorax shining green, the mesonotum and scutellum with reddish brown, the pleura with whitish pollen.

Legs black, the apices of the femora reddish; tibiae yellow, the posterior pair with about the apical fifth black; anterior four tarsi with the basal segment mostly yellowish. Anterior coxae silvery pollinose, clothed with black hairs on the inner half and fine white hairs on the outer half. Femora with short black hair, the posterior pair with a row of short white hairs on the posteroventral surface, the hairs almost one-third as long as the femoral width; posterior and middle femora each with one pre-apical bristle. Anterior tibiae with four bristles above and only one on the posterior surface; middle tibiae with six or seven bristles above and one anteroventral; posterior tibiae with five anterodorsal, four or five posterodorsal, and one ventral bristle; front tarsi shorter than their tibiae, the apical three segments of almost equal length, the fourth the shortest; middle tarsi without dorsal bristles, the basal segment of the posterior tarsi with two.

Wings cinereous hyaline, strongly tinged with brown on the anterior half; costa not enlarged; bend of fourth vein before its middle; posterior border of the wing regular in outline. Squamal cilia black. Halteres yellowish.

Abdomen shining green, the incisures broadly bronzed; sides thinly white pollinose; venter whitish pollinose. Genitalia blackish, thinly pale pollinose, the under side somewhat metallic green basally; lamellae whitish, broadly bordered with black except basally, transverse, the lower edge almost straight, the upper edge very broadly rounded, the apex gently convex and jagged, bearing about six large teeth, the bristles arising from some of the teeth either plain and curved or triangularly expanded at the apex; inner appendages reddish or yellowish.

Types.—Holotype, male, and five paratypes, Baleville, New Jersey, August 5, 1933 (Curran).

The specimens were collected on the side of a board in the stream passing the residence of Mr. A. Klein. They were taken just at dusk and

were entirely absent during the day. The board was kept wet by drops of water thrown up by the current and it seems likely that this species will be found only in such places, as no other specimens were located during two days of collecting. It is possible, of course, that the species might have been found in other nearby places late in the evening.

***Dolichopus shelfordi*, new species (Curran)**

Very similar to *xanthocnemus* Loew but at once distinguished by the presence of five posteroventral bristles on the anterior tibiae. Length, 4 mm.

MALE.—Face moderately wide, silvery white (perhaps brownish above); front shining dark green; upper orbital cilia black, the lower pale yellowish and not squamose. Palpi brown, bearing reddish-brown hairs. Antennae black, the third segment a little longer than wide, obtusely pointed at the apex, the arista arising near the middle.

Thorax shining dark green, thinly cinereous pollinose, the pleura whitish. Scutellum with some delicate whitish marginal hairs.

Coxae black, with reddish tips, thinly cinereous pollinose, the hair wholly black, inconspicuous on the front pair; trochanters reddish; femora black with reddish tips; anterior four tibiae reddish yellow, the posterior pair brownish red with the apical fourth black; tarsi black, the basal segment of the anterior four reddish yellow on the basal three-fourths. Hair black, the femora with tiny yellowish hairs below on the posterior surface, the posterior femora with moderately long, fine, whitish cilia on the apical half of the posteroventral surface; middle and posterior femora each with a single preapical bristle. Anterior tibiae with three anterodorsal bristles, one short posterodorsal bristle near the base, a row of five posteroventrals on the basal two-thirds and two fine ventral bristles; middle tibiae with four anterodorsal, one posterodorsal, and one ventral bristle; posterior tibiae with rows of anterodorsal and posterodorsal bristles and four weak ventral bristles. Posterior tarsi with three dorsal and two posterior bristles; middle tarsi missing; anterior tarsi with the apical three segments of about equal length, the fifth not longer than the fourth.

Wings cinereous hyaline; costa with a small enlargement at tip of first vein; third and fourth veins bent backward apically and parallel before their apices, the bend in the fourth vein well before the middle. Cilia of the squamae black. Halteres reddish yellow.

Abdomen shining dark green, thinly whitish pollinose dorsally and rather thickly so on the sides, the apices of the segments broadly bronzed. Genitalia black, thinly cinereous pollinose; lamellae subquadrate, the apex bluntly rounded and jagged, whitish with black border, the outer edge fringed with fine, curved bristles.

HOLOTYPE.—Male, Mile 474, Hudson Bay Railroad, Manitoba, July 17, 1932 (V. E. Shelford).

D. xanthocnemus has only two posteroventral bristles on the anterior tibiae and lacks ventral bristles.

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KEY TO THE FEMALES OF NEARCTIC *DOLICHOPUS* LATREILLE (DIPTERA)

BY M. C. VAN DUZEE AND C. H. CURRAN

In a recent number of the American Museum Novitates we presented a key to the males of the species belonging to this genus. The females are less well known, and many of the species have been recognized from only the male sex. Females of a few species are so similar that no characters have yet been found for their separation, but almost all can be recognized once the two sexes have been associated.

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- 3.—All the tibiae black.....18.
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- 16.—Basal antennal segment wholly yellow. 17.
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- 17.—Third antennal segment entirely black. 249.
 Third antennal segment yellowish, at least on the base. 256.
- 18.—Femora black, at least one pair mainly black. 19.
 Femora yellow, the tips or extreme base may be blackened. 102.
- 19.—All femora and tibiae black, the knees may be more or less yellow. 20.
 One or more pairs of tibiae and sometimes also one or two pairs of femora
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- 33.—Basal segment of middle tarsi without a bristle above..*monticola* Van Duzee.
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- 34.—Basal segment of middle tarsi mostly whitish.....*stenhammari* Zetterstedt.
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- 35.—Antennae and front coxae wholly black.....*corax* Osten Sacken.
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- 36.—Hind margin of wing expanded a little just basally from tip of fifth vein, so as to form a slight sinus between this point and tip of sixth vein; all tarsi wholly black.....*detersus* Loew.
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- 38.—Basal segment of middle tarsi distinctly yellow at base, sometimes mostly yellow (western).....39.
Middle tarsi wholly black, or mostly so.....41.
- 39.—Front, occiput, and thorax thickly covered with coarse yellowish pollen, which nearly conceals the ground color.....*aethiops* Van Duzee.
Front and thorax metallic as usual.....40.
- 40.—Wings with third and fourth vein distinctly convergent toward their tips.
ovatus Loew.
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- 41.—Middle tarsi more or less yellow at base, usually considerably so; front tibia more or less yellow.....*ovatus* Loew.
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- 42.—Bend in last section of fourth vein near its middle; front femora and tibiae wholly black, or nearly so.....43.
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- 43.—Bend in last section of fourth vein very near its middle.
multisetosus Van Duzee.
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- 44.—Bend in last section of fourth vein about the length of the cross-vein beyond that vein.....*myosota* Osten Sacken.
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- 45.—Front tarsi scarcely as long as the tibia.....*nigrimanus* Van Duzee.
Front tarsi fully as long as their tibiae.....*interjectus* Van Duzee.
- 46.—All femora more than half black.....47.
One or two pairs of femora yellow on more than basal half.....91.

- 64.—Hind tibiae almost wholly black, only a very little yellowish at extreme base.....65.
 Yellow of hind tibiae extending along upper edge for some distance; wings grayish.....67.
- 65.—Wings distinctly and rather uniformly brownish; front and middle tarsi black from the tip of first segment.....*johnsoni* Aldrich.
 Wings wholly grayish, not tinged with brown; front and middle tarsi brownish, or brownish yellow.....66.
- 66.—Bend in last section of fourth vein just before its middle...*calcaratus* Aldrich.
 Bend in last section of fourth vein near basal third.....*mercieri* Parent.
- 67.—Middle tarsi infuscated almost from their base; front tarsi black from tip of first segment.....*laticornis* Loew.
 Front and middle tarsi almost wholly yellow.....68.
- 68.—Hind tibiae with the yellow on upper edge extending to their middle, or nearly so.
gratus Loew.
 Yellow of hind tibiae reaching only to basal fourth, or slightly more.
calcaratus Aldrich.
- 69.—Cilia of the calypters yellow; wings with a faint but distinct cloud at tip, (Alaska).....*mannerheimi* Zetterstedt.
 Not as above.....70.
- 70.—Front tarsi black from tip of first segment or wholly black.....71.
 Front tarsi only a little darkened at tip.....74.
- 71.—Hind femora each with two preapical bristles; bristles on lower part of head all black.....72.
 Hind femora each with one preapical bristle; head with two yellow or whitish bristles below near the proboscis.....73.
- 72.—Face with white pollen.....*nubifer* Van Duzee.
 Pollen on upper part of face yellowish.....*vanduzeei* Curran.
- 73.—Last section of fourth vein nearly straight, only a little bent.
aequalis Van Duzee.
 Bend in last section of fourth vein small, but abrupt.....*alacer* Van Duzee.
- 74.—Front tibiae with two or three bristles on lower anterior edge; all bristles on lower part of head black.....*retinens* Van Duzee.
 Front tibiae with only one small bristle below; head with two yellowish bristles below on each side of proboscis.....*alacer* Van Duzee.
- 75.—Middle and hind femora each with three preapical bristles; middle tibiae with one bristle below, which is unusually long...*partitus* Melander and Brues.
 Middle and hind femora each with one preapical bristle.....76.
- 76.—Hind tibiae wholly black, or extreme base may be yellow.....77.
 All tibiae yellow, at least at base on upper edge for a considerable distance; posterior tibiae black at tip.....78.
- 77.—Middle and hind tibiae yellow; front covered with white pollen, which almost conceals the ground color.....*agronomus* Melander and Brues.
 Middle tibiae black with more or less yellow on upper edge, sometimes yellowish brown; front shining, metallic.....*acuminatus* Loew.
- 78.—Third antennal segment large for a female, somewhat triangular, the arista close to its tip.....*angusticornis* Van Duzee.
 Third antennal segment of normal size, if large the arista is dorsal.....79.

- 79.—First antennal segment yellow below.....*conspicuosus* Van Duzee.
Antennae wholly black, or nearly so.....80.
- 80.—Middle tarsi wholly black; antennae mostly yellow; cilia of calypters yellow.
Undescribed female from Alaska.
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- 81.—Middle tarsi yellow with the tips of the segments broadly black, their anterior
surface with silvery white pollen.....*remipes* Wahlberg.
Middle tarsi black from tip of first segment.....82.
- 82.—Wings with the third and fourth veins convergent toward their tips, where they
are scarcely more than half as far apart as at bend in fourth.
convergens Aldrich.
Third and fourth veins but little convergent beyond the bend in fourth vein. 83.
- 83.—Black at tip of posterior tibiae extending along inner side nearly or quite to
their base.....84.
Black at tip of hind tibiae not extending up inner side to any great extent,
usually not at all.....86.
- 84.—Small hairs on anterior coxae wholly black, or nearly so...*albiciliatus* Loew.
Hairs on front coxae partly white, the white hairs conspicuous on outer half of
anterior surface.....85.
- 85.—Front tarsi scarcely as long as their tibiae, fifth segment as long as third;
orbital cilia silvery white.....*setifer* Loew.
Front tarsi as long as their tibiae; third segment as long as fourth and fifth
together; lower orbital cilia white, but a little tinged with yellow.
burnesi Van Duzee.
- 86.—Orbital cilia wholly black, except one or two near the proboscis.....87.
Many of the lower orbital cilia pale.....88.
- 87.—Last section of fourth vein only a little bent.....*aequalis* Van Duzee.
Last section of fourth vein with a small but rather abrupt bend.
alacer Van Duzee.
- 88.—Hind femora with short, but distinct cilia on lower posterior edge.
albiciliatus Loew.
Hind femora wholly without cilia below.....89.
- 89.—Moderately large species with the bend in last section of fourth vein just before
its middle.....*barbicauda* Van Duzee.
Small species with the bend in last section of fourth vein distinctly before its
middle.....90.
- 90.—Last section of fourth vein straight beyond the bend, third vein bent backward
a little toward its tip, so as to approach fourth.....*xanthocnemus* Loew.
Last section of fourth vein a little arched beyond its bend, so as to be nearly
parallel with third.....*litoralis* Van Duzee.
- 91.—Posterior femora black on basal half or more.....92.
Posterior femora mostly yellowish.....97.
- 92.—Middle femora largely or wholly yellow; anterior and posterior femora black
on basal half or more.....93.
Anterior and middle femora yellow, posterior ones black.....101.
- 93.—Middle and hind femora each with two preapical bristles; hind tibiae black
with base yellow, or yellow with tip and a stripe on posterior side black.
remus Van Duzee.
Middle and hind femora each with one preapical bristle.....94.

- 94.—Middle femora black at base, shading into yellow toward the tip. 95.
 Middle femora mostly yellow on the sides, black at base and on lower edge as far as the middle, or nearly so. 96.
- 95.—Face silvery white; small species; orbital cilia whitish. . . . *xanthocnemus* Loew.
 Rather large species; face gray; orbital cilia yellow. . . . *sedulus* Van Duzee.
- 96.—Orbital cilia wholly black. *groenlandicus* Zetterstedt.
 Lateral and inferior orbital cilia pale. *sedulus* Van Duzee.
- 97.—Orbital cilia wholly black; antennae wholly black; middle and hind femora each with two preapical bristles. *opportunus* Van Duzee.
 Lower orbital cilia pale. 98.
- 98.—First and second antennal segments yellow below. 99.
 Antennae wholly black; hind femora with one preapical bristle. 100.
- 99.—The usual preapical bristle terminating a row of three or four bristles.
amnicola Melander and Brues.
 Hind femora with only one preapical bristle. *maculitarsis* Van Duzee.
- 100.—Hind tibiae mostly yellow. *bryanti* Van Duzee.
 Hind tibiae almost wholly black. *micropyga* Wahlberg.
- 101.—First antennal segment black above, yellow on lower half; lower orbital cilia yellowish. *varipes* Coquillett.
 First antennal segment wholly yellow; orbital cilia wholly black.
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- 102.—Orbital cilia wholly black. 103.
 Lower orbital cilia pale. 114.
- 103.—Front coxae black or green, the tips may be yellow. 104.
 Front coxae yellow, the outer side may be more or less black or green. . . . 106.
- 104.—First and second antennal segments yellow below. *bruesi* Van Duzee.
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- 105.—Front violet. *pachycnemus* Loew.
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- 106.—Basal segment of middle tarsi with a large bristle above. 107.
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- 107.—First antennal segment yellow. *dorycerus* Loew.
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- 108.—Face brownish. *brevipennis* Meigen.
 Face white. *ungulatus* Linnaeus.
- 109.—Basal segment of posterior tarsi with only one large bristle above; small shining species. *barbipes* Van Duzee.
 Basal segment of posterior tarsi with more than one large bristle above. . . 110.
- 110.—Front thickly covered with brown pollen, nearly or quite concealing the ground color. *rupestris* Haliday.
 Front metallic, shining. 111.
- 111.—Antennae wholly black, the posterior tibiae always broadly black apically. . 112.
 First and second antennal segments yellow below, or the posterior tibiae wholly yellow. 113.
- 112.—Hind tibiae black at tip for nearly or quite one-third their length.
brevipennis Meigen.
 Hind tibiae black at tip for about one fifth their length. . . *lundbecki* Curran.

- 113.—Orbital cilia wholly black. *bruesi* Van Duzee.
 Lower orbital cilia yellow with from one to six black bristles on each side next to the proboscis. *consanguineus* Wheeler.
- 114.—Cilia of the calypters pale. 115.
 Cilia of the calypters black. 141.
- 115.—Antennae black, although the first and second segments may be yellow below. 116.
 At least first antennal segment wholly yellow. 137.
- 116.—Front coxae blackened at base for half their length or more, sometimes the yellow extending to the base on inner side. 117.
 Anterior coxae yellow, at least on anterior surface. 120.
- 117.—Hind femora and tibiae each with a black tip. *fucatus* Van Duzee.
 Hind femora wholly yellow. 118.
- 118.—Hind tibiae black at tip for one-fourth the length. *pilatus* Van Duzee.
 Hind tibiae wholly yellow. 119.
- 119.—Hind tarsi wholly black. *longimanus* Loew.
 Hind tarsi yellow at base. *californicus* Van Duzee.
- 120.—Hind tibiae distinctly blackened at tip. 121.
 Hind tibiae wholly yellow, or nearly so. 125.
- 121.—Middle tibiae with three bristles below, one near basal third and two near apical third. *albicoxa* Aldrich.
 Middle tibiae with only one bristle below, placed near apical third; cilia of the calypters more or less black. 122.
- 122.—Front coxae wholly yellow; last three segments of front tarsi of nearly equal length. *indigena* Van Duzee.
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- 123.—Fifth segment of front tarsi yellowish, paler than the joints preceding it. *socius* Loew.
 Fifth segment of front tarsi black. 124.
- 124.—Front and middle tarsi brownish black, rather small species. *socius gladius* Van Duzee.
 Front tarsi deep black. *serratus* Van Duzee.
- 125.—Anterior coxae with a green or blackish streak on outer posterior edge. *crenatus* Osten Sacken.
 Anterior coxae wholly yellow, or with a small blackish spot on outer surface at base. 126.
- 126.—Hind tarsi wholly black, or nearly so. 127.
 Basal segment of posterior tarsi largely yellow. 132.
- 127.—First antennal segment yellow below. 128.
 Antennae wholly black, or nearly so. 130.
- 128.—Front coxae wholly yellow; basal segment of middle tarsi without a bristle above. 129.
 Front coxae with a blackish spot at base on outer surface; basal segment of middle tarsi with a bristle above. *nudus* Loew.
- 129.—Third antennal segment wholly black. *albicoxa* Aldrich.
 Third antennal segment largely yellow. *longicornis* Stenhammar.

- 130.—Cross-vein long, nearly equaling the distance to the bend in fourth vein which is near basal third of the last section. *palaesticus* Loew.¹
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 Bend in last section of fourth vein at second fifth. *splendidulus* Loew.¹
- 132.—Basal segment of middle tarsi without a bristle above. . . *bolsteri* Van Duzee.
 Basal segment of middle tarsi with a large bristle above near apical third. . 133.
- 133.—Basal segment of middle tarsi with two bristles above near basal third, the one on anterior edge may be the smallest. 134.
 Basal segment of middle tarsi with only one large bristle above. 135.
- 134.—Antennae wholly black, especially when viewed from above. . . *batillifer* Loew.
 First antennal segment distinctly yellow below. *tonsus* Loew.
- 135.—Facial pollen with yellowish tinge. 136.
 Facial pollen pure whitish. *versutus* Van Duzee.
- 136.—Face slightly yellowish. *dakotensis* Aldrich.
 Face distinctly tinged with yellow. *eudactylus* Loew.
- 137.—Middle tarsi wholly deep black. Undescribed species from Alaska.
 Basal segment of middle tarsi yellow with a black tip. 138.
- 138.—Basal segment of middle tarsi with a large bristle above. . . *variabilis* Loew.
 Basal segment of middle tarsi without a bristle above. 139.
- 139.—Middle tibiae with one bristle below; all segments of front tarsi blackened at tip. *celeripes* Van Duzee.
 Front tarsi almost wholly yellow; middle tibiae with one or three bristles below. 140.
- 140.—Middle tibiae with one bristle below. *tener* Loew.
 Middle tibiae with three bristles below. *luteipennis* Loew.
- 141.—Tips of hind tibiae black. 142.
 Hind tibiae wholly yellow, sometimes a little blackened on inner side. . . . 193.
- 142.—Tips of hind femora black, at least above. 143.
 Hind femora wholly yellow. 150.
- 143.—Anterior coxae yellow, at most with a small blackish spot at base on outer side. 144.
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- 144.—Middle and hind femora each with one preapical bristle. . . . *comatus* Loew.
 Middle and hind femora each with two or three preapical bristles. *trisetosus* Van Duzee.
- 145.—Anterior femora brownish on upper edge, the brown color rarely faint. . . . *affluens* Van Duzee.
 Front femora not darker on upper edge. 146.
- 146.—Last section of fourth vein nearly straight, with only a slight bend, which is close to its middle. *sincerus subdirectus* Van Duzee.
 Last section of fourth vein with a small, but distinct bend, which is situated before its middle. 147.
- 147.—First antennal segment yellow below. *discolor* Van Duzee.
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¹The main characters separating these species are unsatisfactory.

- 143.—Front coxae almost wholly black..... *sincerus* Melander and Brues.
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- 149.—Tips of hind femora black for the length of the preapical bristle, the black
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- 153.—Arista with first segment very long; middle tibiae with a brown ring.
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- 154.—Antennae black, the first and second segments sometimes yellow below..... 155.
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- 156.—Last section of fourth vein with a stump-vein at bend..... 157.
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- 157.—Middle tibiae with one bristle below, placed near the middle of lower anterior
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- 158.—Wings with a brown spot along the costa near the tip..... *ornatipennis* Van Duzee.
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- 159.—Middle and hind femora each with two preapical bristles.
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- 160.—Second antennal segment wholly black..... 161.
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- 161.—Basal segment of middle tarsi with a large bristle above.
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- 162.—Hind tibiae blackened at tip for one-fourth their length..... *reflectus* Aldrich.
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- 166.—Front coxae nearly half black. *pilatus* Van Duzee.
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sicarius Van Duzee.
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REVIEW OF THE TACHINID GENUS *CALODEXIA* VAN DER WULP (DIPTERA)

BY C. H. CURRAN

The genus *Calodexia* was established by Van der Wulp in 'Biologia Centrali-Americana' in 1891 and included three species, the first of which, *majuscula*, was selected as the genotype by Coquillett in 1910. The other two species do not belong to the genus, and their generic position is doubtful. In 1868 Schiner had described a species from Brazil, placing it in the genus *Meigenia*, and three additional species were described by Townsend in 1912 and 1915, each distributed in a new genus. The species described by Schiner and Van der Wulp were based on male specimens, while Townsend's species were all described from females.

The habits of the species of *Calodexia* are peculiar, but nothing is known about the immature stages. The genus is restricted to tropical America, and the females may be found in large numbers associated with moving armies of ants, but in not quite the same way as are the species of *Stylogaster*.¹ Whereas the species of *Stylogaster* hover over the ant army, the females of *Calodexia* sit upon foliage in front of the army or to either side near the front. They sometimes occur in thousands, and as they fly from leaf to leaf to keep ahead of the moving army they create a buzzing that may be heard for a distance of more than twenty feet. In every case in which I located armies of ants I was attracted by the noise of the flies.

One can only conjecture concerning the immature stages. From my observations I feel confident that the eggs or larvae are deposited upon cockroaches, of which large numbers are driven from their hiding places by the ants. As soon as a cockroach appears dozens of flies will dart toward it, apparently in an endeavor to oviposit. Whether they succeed or not, I cannot say, but from this it appears that the species of *Calodexia* are parasitic on cockroaches and that their association with the ants is due to the assistance rendered in locating the host.

Males are seldom, if ever, found associated with ants, and this renders the association of the two sexes very difficult, although not much assistance would be afforded, since half a dozen species usually occur

¹See Aldrich, 1930, Proc. U. S. N. M., LXXVIII, Art. 9, pp. 4 and 5.

together. The males sit about on foliage along the trails or in clearings and are remarkably rare considering the abundance of females. The males of only four species have been associated with females, and no females are known of five of the species. Only by a study of the chaetotaxy and mesonotal markings can the two sexes be associated. The abdominal pattern is very similar in all known males, but the color of the legs appears to be fairly constant in the two sexes.

I am greatly indebted to Dr. J. M. Aldrich for the loan of unnamed material in the United States National Museum, thus increasing the scope of this review of the genus, and to Mr. Nathan Banks for the loan of specimens from the Museum of Comparative Zoölogy. Unless otherwise stated, the types are in The American Museum of Natural History.

Calodexia Van der Wulp

VAN DER WULP, 1891, 'Biol. Cent.-Amer.,' Dipt., II, p. 257.

Oestrogaster TOWNSEND, 1912, Proc. U. S. N. M., XLIII, p. 309.

Oestrogastropsis TOWNSEND, 1915, Proc. U. S. N. M., XLIX, p. 424.

Oestrogastrodes TOWNSEND, 1915, Proc. U. S. N. M., XLIX, p. 425.

Head short, the eyes large, leaving the cheeks very narrow, never more than one-twelfth as wide as the eye-height; parafacials narrow, narrowing below; front narrow, with rather parallel sides, the lowest pair of frontals usually situated below the upper edge of the antennae, the upper two pairs strong and reclinate; ocellars short and weak or absent; two pairs of proclinate orbitals in the female; outer verticals developed in the females; face rather flat; proboscis short, the palpi gradually enlarged from near the base but not swollen. Antennae long; arista practically bare or very short plumose on the basal half or less, the upper rays longest, the lower sometimes practically absent; eyes bare. Acrosticals variable, usually 1-1, often 1 or 2-3, rarely entirely absent or only the prescutellar pair present; dorsocentrals, 2-3; two or three intra-alars, the anterior pair often absent or short; posterior sublateral and posthumeral bristles absent. Scutellum with two to four pairs of marginals, the apical pair always weak, hairlike or absent, divergent when present, the second pair weak or absent; sternopleurals, 1-1; infrasquamal setulae usually present. Legs of normal length; middle femora with one or two anterior bristles near the middle, the middle and posterior femora sometimes short ciliate below in the males; middle tibiae with or without a ventral bristle beyond the middle; anterior tibiae with one posterior bristle. Wings normal, the third vein with two to six short basal bristles. Squamae large. Abdomen of the male elongate, tapering, the sides very gently convex or almost straight; first segment with pair of marginals and one lateral marginal; second segment with pair of marginals and one lateral marginal, rarely with an incomplete row of weak marginals; third segment with pair of discals and row of marginals; fourth with one or two rows of discals and row of marginals, rarely with only one pair of discals. In the female the abdomen is short and oval, deep and slightly keeled below, the genital opening entirely ventral, the ovipositor emerging between the sides of the third tergite or just behind, almost always in front of the posterior dorsal edge of the third tergite; fourth segment sloping toward the base of the abdomen from about the basal fourth, or perpendicular,

the apex of the abdomen very obtuse; chaetotaxy as in the male except on the fourth segment where there is usually a very strongly arched row of discals, rarely an extra pair of discals above the arch, rarely only one pair of discals, and usually a row of marginals on either side of the genital opening.

This genus contains twenty-three species, of which eighteen are described for the first time. The following key will separate the known species.

TABLE OF SPECIES

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|--|--------------------------------|
| 1.—Pile of the occiput black. | 2. |
| Pile of the occiput white or yellowish | 3. |
| 2.—Pale pollinose fascia on second abdominal segment broadly interrupted in the middle. | <i>fumosa</i> Townsend. |
| Pale pollinose fascia entire. | <i>aldrichi</i> , n. sp. |
| 3.—At least one pair of acrostical bristles. | 5. |
| No acrosticals. | 4. |
| 4.—Posterior femora broadly reddish basally. | <i>fulvibasis</i> , n. sp. |
| Legs wholly blackish. | <i>townsendi</i> , n. sp. |
| 5.—At least one pair of presutural acrosticals. | 6. |
| No presutural acrosticals. | <i>dives</i> , n. sp. |
| 6.—Three pairs of postsutural acrosticals. | 7. |
| Only one pair of postsutural acrosticals present. | 10. |
| 7.—Third abdominal segment wholly pale pollinose in front of the marginal bristles. | 9. |
| Third abdominal segment with the dark fascia extending to well in front of the marginal bristles. | 8. |
| 8.—Dark postsutural fascia not interrupted between the median and outer vittae but united by rusty-brown pollen. | <i>valera</i> , n. sp. |
| Dark postsutural fascia conspicuously interrupted by cinereous stripes separating the median and outer vittae. | 22. |
| 9.—Acrosticals 2-3. | <i>mexicana</i> Townsend. |
| Acrosticals 1-3. | <i>varia</i> , n. sp. |
| 10.—Middle tibiae with strong ventral bristle near or beyond the middle. | 11. |
| Middle tibiae without ventral bristle. | <i>fusciata</i> , n. sp. |
| 11.—Femora reddish on basal third or more, at least on the ventral surface. | 12. |
| Femora blackish, the apices sometimes reddish. | 19. |
| 12.—Infrasquamal cilia black or absent. | 13. |
| Infrasquamal cilia yellow. | <i>majuscula</i> Van Der Wulp. |
| 13.—The median black mesonotal vittae are united immediately behind the suture, forming a black fascia (posterior view). | 15. |
| The median pale vitta extends to well behind the suture. | 14. |
| 14.—Posterior femora with short yellow cilia on both edges of the ventral surface (female unknown). | <i>flavipes</i> Schiner. |
| Posterior femora with a single ventral row of pale cilia in the male; abdomen of female deep black, with whitish pollen. | <i>major</i> , n. sp. |
| 15.—Pile of the mesopleura rather coarse and black. | 17. |
| Pile of the mesopleura very fine and wholly whitish. | 16. |

- 16.—First abdominal segment reddish with median black vitta. *venteris*, n. sp.
 First abdominal segment black above. *similis* Townsend.
- 17.—All the vittae united behind the suture or the outer ones separated by a line. . 18.
 Outer vittae broadly separated on their whole length. *agilis*, n. sp.
- 18.—Fourth abdominal segment with arched row of discals. *insolita* Curran.
 Fourth abdominal segment with pair of discals and a row of marginals.
apicalis, n. sp.
- 19.—Pleura with fine whitish hair. 20.
 Pleura with coarser black hair. *bella*, n. sp.
- 20.—Middle femora with two anterior bristles near the middle. 21.
 Middle femora with a single anterior bristle. *caudata*, n. sp.
- 21.—Anterior coxae with coarse black hair. *interrupta*, n. sp.
 Anterior coxae with fine whitish hair and black bristles. *continua*, n. sp.
- 22.—Third antennal segment very broadly reddish basally on the under surface.
panamensis, n. sp.
 Third antennal segment with only the immediate base reddish. . *bequaerti*, n. sp.

Calodexia aldrichi, new species

Black, the middle tibiae without a bristle below; pleura black-haired; dark post-sutural fascia entire. Length, 5.25 mm.

FEMALE.—Head white pollinose. Front with parallel sides, slightly narrowed at the vertex, about two-fifths as wide as either eye; eight or nine pairs of frontals, the upper two reclinate; ocellars absent; outer verticals strong. Occiput with black hair, the occipital cilia extending almost to the cheeks. Cheeks very narrow, with a row of black bristles. Proboscis brownish; palpi reddish brown, with black hair. Antennae brown; arista very short pubescent basally.

Thorax cinereous-white pollinose. Mesonotum in front of the suture with a pair of black stripes and outside these a large, suborbicular black spot which is continued broadly along the inner border of the humeri, all the black markings well separated from the suture. Behind the suture the mesonotum is black with a broad, pale pre-scutellar fascia. Scutellum wholly blackish, with three pairs of marginals and no apical hairs in the type. Acrosticals, 1-1; anterior intra-alar rather well developed.

Legs blackish, the anterior coxae somewhat paler, pale pollinose; middle tibiae without ventral bristle.

Wings cinereous hyaline, with slight brown tinge. Squamae pale brownish, the base broadly white. Halteres yellow.

Second abdominal segment with almost the basal half white pollinose dorsally, the pollen quite thin in the middle of the dorsum except on the base of the segment and expanding to occupy more than half the segment at the sides and beneath, but not reaching the lateral margins of the tergites; third segment similar, but the pollen is denser toward the middle of the dorsum where it is broadly interrupted; fourth segment white pollinose with a very broad, bare, vertical median stripe extending from the base to the apex. First segment with a pair of marginals, the second and third each with a row, these segments also with a pair of discals; fourth segment with the arched row of discals and a pair of discals above the arch. Hair wholly black.

TYPE.—Female, Chapada, Brazil (Williston Collection).

This species is very similar to *fumosa* Townsend, differing in having the pollinose fascia on the second abdominal segment entire, a very much

stronger anterior intra-alar bristle, more numerous marginal bristles on the third abdominal segment, and more discals on the fourth, and larger size.

Calodexia fumosa Townsend

Oestrogaster fumosus TOWNSEND, 1912, Proc. U. S. N. M., XLIII, p. 309.

A small, black species with white fasciate thorax and abdomen, the pollinose fascia on the second segment conspicuously interrupted in the middle. Length, 3.5 to 4 mm.

Thirteen females, Barro Colorado Island, Canal Zone, December 23, 25, 26, and 29, 1928 (Curran); eight females, Barro Colorado, July 23, 26, 1924 (N. Banks).

This species is very similar in appearance to *aldrichi*, new species, but may be at once distinguished by the interrupted pale pollinose fascia on the second abdominal segment and its smaller size.

Calodexia fasciata, new species

Middle tibiae without ventral bristle; postsutural black fascia interrupted laterally; pleural pile black. Length, 5.5 to 7 mm.

FEMALE.—Head white pollinose, the upper half of the front and upper third of the posterior orbits rather ochreous. Front slightly more than one-third as wide as either eye, with almost parallel sides but distinctly narrowed at the vertex; six to eight pairs of frontals, the upper two reclinate, the anterior pair sometimes situated below the base of the antennae; two pairs of strong orbitals; ocellars hairlike but conspicuous; outer verticals strong. Occiput with very pale yellowish or whitish hair, the black occipital cilia extending to the middle of the eyes. Cheeks linear, with two or three black bristles. Parafacials narrow, narrowing below. Proboscis brown, with yellow labellae; palpi reddish yellow, with black hair. Antennae reddish yellow, the third segment brownish apically; arista brown with reddish base, short pubescent on the basal third.

Thorax cinereous pollinose, the mesonotum often with strong ochreous tinge. Four short, black mesonotal vittae in front of the suture, all broadly separated from the black postsutural fascia which is interrupted above the roots of the wings. Base of the scutellum broadly blackish; two pairs of marginals, a third very weak pair sometimes present and usually a pair of hairs between the apical pair. Acrosticals, 1-1, although there may be a second pair of weak presuturals; anterior intra-alar absent or very weak. Pleura with black hair.

Legs blackish; anterior coxae usually mostly reddish yellow; trochanters reddish yellow, the middle femora with the basal fifth, the hind pair with the basal third, reddish yellow, the tips of the femora often reddish, the anterior pair sometimes more or less reddish at the base below; hair black.

Wings cinereous hyaline. Squamae light brownish, with whitish base. Halteres yellow.

Abdomen black, with cinereous or cinereous-yellow pollinose fasciae. Pale fascia occupying the basal third of the second segment toward the sides and expanded in the

middle and on the under surface; band on the third segment occupying almost or fully the basal two-thirds dorsally, the fourth segment pale pollinose with a broad, vertical, pale brownish stripe; pollen becoming white on the venter. First and second segments each with a pair of marginals, the third with a row; second and third segments each with a pair of discals, the fourth with a narrow, arched row which is irregular, containing some additional bristles outside the row.

Types.—Holotype, female, Barro Colorado Island, Canal Zone, December 29, 1928 (Curran). Paratypes: nineteen females, Barro Colorado Island, December 25, 26, 29, 1928 (Curran); six females, Barro Colorado Island, November 20, 1930 (F. E. Lutz); three females, Barro Colorado Island, July 26, 1924 (N. Banks).

Calodexia dives, new species

Readily recognized by the pale pilose pleura, black legs, and absence of presutural acrostical bristles. Male unknown. Length, 7.5 to 9 mm.

FEMALE.—Head white pollinose, the upper half of the parafrontals and the upper posterior orbits more or less yellowish. Front scarcely half as wide as either eye, gently widening to the middle, the sides almost parallel on the anterior half; six to eight pairs of frontals, the upper two reclinate, the anterior pair situated below the base of the antennae; two pairs of proclinate orbitals; ocellars scarcely developed; outer verticals strong. Occiput with whitish hair, the black occipital cilia extending to the lowest fourth of the eye. Cheeks very narrow, with a row of three or four black bristles. Parafacials moderately wide above, becoming very narrow below. Proboscis brown, labellae yellow; palpi reddish yellow, with black hair. Antennae brownish, the base of the third segment broadly yellow, the basal segments usually brownish red; arista brown, very short plumose on the basal third, the base more or less reddish.

Thorax cinereous pollinose, the mesonotum and scutellum usually with strong ochreous tinge and sometimes quite strongly ochreous. Median black vittae rather wide, replaced on the posterior fourth by a brown median vitta, the outer vittae continuous and extending to the posterior dorsocentral; base of scutellum broadly blackish; four pairs of marginal scutellars, the apical pair divergent; acrosticals, 0-1; anterior intra-alar well developed. Pleura white pilose, the notopleura with black hair.

Legs black; the trochanters reddish, the anterior coxae appearing brownish red in some lights; coxae cinereous pollinose and with fine whitish hair. Middle tibiae with a bristle below.

Wings cinereous hyaline, distinctly clouded with brown on more than the apical half. Disc of squamae pale brown. Halteres yellow.

Abdomen black, with cinereous pollen, the tips of the tergites yellow on the under side. Second segment pale pollinose on more than the basal half, the fascia distinctly broadened on the median third; third segment with the pale pollinose fascia wider, the fourth wholly pale pollinose; discal bristles on second and third segments arising from dark spots. First and second segments each with a pair of strong marginals, the third with a row, the fourth with a row of weaker bristles along the sides of the genital opening; second and third segments each with a pair of discals, the fourth with a row. Hair black, very broadly pale along the middle of the venter from the base to the fourth segment.

Types.—Holotype, female, Barro Colorado Island, Canal Zone, December 25, 1928. Paratypes: nineteen females, Barro Colorado Island, December 23, 25, and 29, 1928 (Curran).

Calodexia fulvibasis, new species

Black, the broad bases of the posterior femora reddish; no acrostical bristles. Length, 6 mm.

FEMALE.--Head whitish pollinose. Front two-fifths as wide as either eye, the brown vitta wider than either parafrontal; seven or eight pairs of frontals, the upper two reclinate, the lower two small and situated below the base of the antennae; two pairs of orbitals; ocellars very small; outer verticals weak. Occipital pile pale yellowish, the black occipital cilia extending to below the middle of the eyes. Cheeks very narrow, with a row of black bristles. Parafacials very narrow except above. Proboscis brown; labellae yellow; palpi reddish yellow, the hair mostly coarse and black. Antennae brown, the incisures dull reddish; arista pubescent above and below on basal third.

Thorax cinereous-white pollinose; mesonotum with four black vittae, the outer pair wide and extending almost to the scutellum, the inner pair narrower, extending to well behind the suture where the pollen between them is yellowish brown. Scutellum blackish, with narrow cinereous border, bearing three pairs of marginals but the median pair is very weak. Hair wholly black. No acrosticals; two intra-alars.

Legs blackish; posterior femora reddish on the basal half, the middle pair broadly reddish basally on the posterior surface; middle tibiae with ventral bristle.

Wings strongly tinged with brown. Squamae brownish except on the broad base, the rim yellowish. Halteres yellow.

Abdomen black, with cinereous-white pollen which becomes white on the under surface. On the second and third segments the pollen forms a narrow basal fascia and expands strongly just at the lateral margins where it occupies more than the basal half of the segments and is even more extensive toward the sides of the under surface; in the middle of the dorsum it expands greatly but is thin and more grayish, but it leaves a median, dark vitta. Fourth segment cinereous pollinose with a broad, median vertical pale brown stripe. First and second segments with pair of marginals, the third with a row; second and third segments each with a pair of discals; fourth segment with an arch of four discals and with fine bristles on the sides of the genital opening. Hair black, yellow on the under surface of the first segment and on the second sternite.

HOLOTYPE.--Female, Huascaray Ridge, Prov. Jaen, Peru, 7000 ft., September 22 (C. H. T. Townsend), in U. S. N. M.

Calodexia townsendi, new species

Black, with rather plumbeous pollen; no acrosticals. Length, 6 mm.

FEMALE.--Head with rather plumbeous pollen. Front about half as wide as either eye, the black vitta much wider than either parafrontal; eight or nine frontals, the upper two reclinate, the lower one or two situated below the base of the antennae; two pairs of orbitals; ocellars moderately long; outer verticals more than half as long as the verticals. Occipital pile whitish, the black occipital cilia extending to the lower border of the eyes. Cheeks narrow, with a row of black bristles. Parafacials narrow, tapering below. Proboscis black, the labellae dull reddish. Palpi reddish brown with paler apices, the hair black. Antennae black, the arista pubescent above on basal third or more.

Thorax rather plumbeous pollinose; mesonotum with four weak, brown vittae, the median and outer ones more or less united well behind the suture. Scutellum

blackish, with plumbeous border, bearing three pairs of marginals and a pair of apical hairs. Hair black; no acrosticals and only two intra-alars.

Legs black; middle femora with a single anterior bristle near the middle; middle tibiae with strong ventral bristle.

Wings with brown tinge, the costal border narrowly brown. Squamae brownish with whitish base, the rim yellow. Halteres yellow.

Abdomen black, with thin, grayish-brown pollen, and rather plumbeous pollinose fasciae. The pale pollen on the second and third segments forms narrow basal fasciae that expand strongly toward the sides and continue over the under surface; fourth segment pale pollinose, with a rather narrow, vertical brown vitta in the middle. First and second segments each with a pair of marginals, the third with a row; second and third segments each with a pair of discals. Fourth segment with an arched row of six discals the lower pair fine and more approximate, the sides of the genital opening with fine bristles. Hair wholly black.

HOLOTYPE.—Female, Huascaray Ridge, Prov. Jaen, Peru, 7000 ft., September 22 (C. H. T. Townsend), in U. S. N. M.

This species and *fulvibasis*, new species, form a distinct group characterized by the entire absence of acrostical bristles, but they are approached in this respect by *dives*, new species, which has only the pre-scutellars present.

Calodexia bella, new species

Black, with cinereous pollen, the abdomen partly reddish; postsutural fascia entire; acrosticals, 2 or 3-1. Length, 6 to 8 mm.

MALE.—Head white pollinose, the parafrontals and upper part of the posterior orbits pale golden or brassy yellow. Front about two-fifths as wide as either eye, gently widening anteriorly and toward the vertex; about ten pairs of frontals, the lowest situated at most slightly below the base of the antennae, the upper two reclinate but not much stronger than the others; ocellars very weak; frontal vitta brown, about as wide as either parafrontal. Occiput with white or yellowish-tinged hair, the black occipital cilia extending to below the middle of the eyes. Cheeks narrow, with a row of black bristles. Parafacials narrow, narrowing below, mostly yellowish. Proboscis brown, the labellae reddish brown; palpi rather dull reddish-yellow, with black hairs. Antennae reddish, the third segment mostly brown; arista brown, almost bare, reddish basally.

Pollen of thorax usually with ochreous tinge. Mesonotum with four presutural black vittae and a wide, entire black fascia behind the suture, the fascia deeply emarginate above the roots of the wings from some views. Scutellum with the base broadly black, with two pairs of strong marginals and sometimes a very weak third pair, the apicals absent. One strong and one or two pairs of weak presutural acrosticals and a single postsutural pair; anterior intra-alar short. Hair black.

Legs black, the trochanters reddish; coxae appearing partly reddish; middle tibiae with ventral bristle.

Wings tinged with brown. Squamae with brown tinge, the border pale yellowish. Halteres yellow.

Abdomen black and reddish yellow with cinereous or cinereous-yellow pollen above and white pollen below. Second segment with the basal two-thirds to three-

fourths reddish yellow except for a broad median vitta; third segment with basal half pale except on the broad middle; first segment usually broadly pale posteriorly on the sides and under surface. Almost the basal third of the second and third segments pale pollinose, the pollen expanding medianly on the dorsum, and somewhat irregular in width on the sides and under surface; fourth segment with about the basal half pollinose, but the median third appears dark in some lights. Hair black. First and second segments each with a pair of marginals the third and fourth each with a row; second to fourth segments each with a pair of discals.

Types.—Holotype, male, Barro Colorado Island, Canal Zone, December 25, 1928. Paratypes: twelve males, Barro Colorado Island, December 22, 23, 25, 28, 1928, and January 3, 1929 (Curran).

Despite the presence of the ventral bristle on the middle tibiae I think the specimens here described are the males of *fasciata*, new species, but I hesitate to associate the two without more evidence. The shape of the black mesonotal markings would seem to indicate this, but the presence of the tibial bristle appears to throw the specimens into a different group. I have been unable to associate any males with the *fumosa* group, and, since two of the species are common, this seems very strange, although males are unknown of some of the other common species.

Calodexia interrupta, new species

Pleura with pale yellowish hair; legs black, the middle tibiae with ventral bristle: one pair of presutural acrosticals; coxae with black hair. Length, 5.5 to 8 mm.

MALE.—Head black in ground color, the parafacials yellowish; pollen whitish, rather golden on the front and upper half of the posterior orbits. Front one-third as wide as either eye, slightly widening on the anterior half; vitta brown, narrower than either parafrontal except above; ten pairs of orbitals, the lowest situated below the base of the antennae, the upper two strong and reclinate; ocellars very weak. Occiput with white hair, the black occipital cilia extending only to the middle of the eyes. Cheeks very narrow, with a row of black bristles. Parafacials narrow and narrowing below. Proboscis brown; labellae and palpi yellow, the palpi with black hairs. Antennae reddish yellow, the second segment and sometimes the apex of the third tinged with brown; arista brown with reddish base, very short plumose on the basal third.

Mesonotum with cinereous-yellow pollen and four blackish vittae, the median vittae fused behind the suture and with a backward projection in the middle so that all three stripes end about the same distance in front of the scutellum; outer vittae interrupted at the suture. Scutellum cinereous yellow with the base broadly dark, bearing three pairs of marginals and a pair of apical hairs. Pleura cinereous pollinose and with pale yellowish hair.

Legs black; coxae cinereous pollinose and with black hair; trochanters reddish. Middle and posterior femora closely ciliate on the apical two-thirds of the ventral surface with long black or rather golden-brown hairs. Middle tibiae with ventral bristle.

Wings cinereous hyaline, with more or less brownish tinge. Squamae whitish with brownish tinge on the disc. Halteres yellow.

Abdomen reddish and brown with cinereous-yellow pollen, the pollinose fasciae becoming white on the under side of the second and third segments. First segment brown with about the apical half dull reddish except on the broad middle line, the reddish color extending broadly to the base at the ventral edges; second segment dull reddish with about the apical half appearing brown, the brown fascia broadly narrowed in the middle; third segment with only a little more than the apical third brownish, the fourth with only the apical fourth brown above. First and second segments each with a pair of marginals, the third and fourth each with a row; second and third segments with pair of discals, the fourth with a row. Genitalia reddish. From posterior view the abdomen appears mostly reddish, since the brown fasciae are partly due to pollen.

FEMALE.—Quite different in appearance. Front about two-thirds as wide as either eye; six or seven pairs of frontals, the upper two reclinate, and two pairs of strong proclinate orbitals; parafrontals usually paler but always with strong yellow tinge, the markings as in the male. Femora without the long cilia below, but the hairs on the apical half of the anteroventral surface of the posterior femora decidedly longer than in allied species. Abdomen blackish or dark brown, only appearing partly reddish when viewed from below; pale pollen on second segment almost as in the male, in the middle occupying almost the basal two-thirds and gradually narrowing to a little more than the basal half at the lateral third. On the third segment the pale pollen occupies about the basal two-thirds and extends very broadly to the apex in the middle. The fourth segment is wholly pollinose, although the pollen is thinner or brownish on the usual vertical apical portion, the segment with the arched row of strong discal and an incomplete arch of fine bristles, the arch broken above.

TYPES.—Holotype, male, and allotype, female, Barro Colorado Island, Canal Zone, December 21, 1928 (Curran). Paratypes: one male and fourteen females, Barro Colorado, December 22, 23, 25, 26, 29, and January 11, 1929 (Curran).

I had first associated these males with *continua*, new species, but they must belong here because of the color of the hair on the front coxae and the similar mesonotal markings. The acrosticals are 1-1, and the anterior intra-alar is well developed though decidedly weaker than the others. The discals on the second and third abdominal segments arise from small dark spots. The hair of the mesopleura is rarely partly black or brown.

Calodexia continua, new species

Legs black; pleura and front coxae white-haired; mesonotum with transverse black band behind the suture. Length, 7 to 8.5 mm.

FEMALE.—Head white pollinose, the parafrontals and upper third of the posterior orbits with strong yellow tinge. Front half as wide as either eye, slightly widening from the vertex to the middle; frontal vitta brown, much narrower than either parafrontal; six to eight pairs of frontals, usually one below the base of the antennae, the upper two reclinate; two pairs of orbitals; ocellars very weak. Occiput white-haired, the black occipital cilia extending to about the middle of the eyes. Cheeks very narrow, with row of black bristles. Parafacials rather narrow, becoming very narrow below. Proboscis brown; the labellae pale yellow. Palpi reddish yellow, with black

hairs. Antennae reddish yellow, the second segment and apex of the third more reddish or with slight brown tinge; arista brown, broadly reddish basally, very short, pale plumose on the basal fourth.

Thorax cinereous pollinose, the mesonotum and scutellum usually with yellowish tinge; mesonotal vittae fused behind the suture to form a transverse blackish fascia, although the median and outer vittae are very narrowly separated by a gray line; the outer ends of the black fascia are slightly produced backward and there is a small median black spur, the outer vittae broadly interrupted at the suture. Scutellum with the base broadly blackish, bearing three pairs of marginal bristles and a pair of apical hairs. Hair on pleura, notopleura, and lower border of the humeri white. Acrosticals, 1-1; anterior intra-alar well developed.

Legs black; anterior coxae largely reddish and bearing white hair; trochanters reddish; middle tibiae with a bristle below.

Wings cinereous hyaline, with brownish tinge. Squamae white, the disc lightly tinged with brown. Halteres yellow.

Abdomen black, with cinereous pollen, the pollen white on the under side. Second segment with slightly more than the basal half pale pollinose, the fascia expanding in the middle and on the under side; third segment similar but the pollinose fascia somewhat wider; fourth segment pale pollinose, but the perpendicular apex is broadly brownish red. From ventral view the abdomen appears reddish with broad brownish fasciae just before the apices of the tergites. Hair black, pale along the middle of the venter. First and second segments each with a pair of strong marginals, the third with a row, the fourth with a row of fine bristles along the sides of the genital opening; second and third segments each with a pair of discals, the fourth with a row. Genitalia yellowish.

Types.—Holotype, female, Barro Colorado Island, Canal Zone, December 25, 1928 (Curran). Paratypes: nine females, Barro Colorado Island, December 23, 25, 29, 1928 (Curran); four females Barro Colorado Island, July 26, 1924 (N. Banks); female, Cano Saddle, Canal Zone, May 8, 1923 (R. C. Shannon); female, Polochic River, Guatemala, above Panzos, May 26, 1926 (J. M. Aldrich).

Calodexia flavipes Schiner

Meigenia flavipes SCHINER, 1868, 'Novara Reise,' p. 326. ALDRICH, 1929, Proc. U. S. N. M., LXXIV, Art. 19, p. 22 (male only).

I am unacquainted with this species although there is a specimen in the United States National Museum that has been compared with the type. I doubt the correctness of the identity because a specimen before me agrees with the U. S. N. M. specimen but does not agree with Schiner's description, differing in many respects.

Schiner described *flavipes* from a male from Brazil, and the description agrees quite well with the male of *major*, new species, and *majuscula* Van der Wulp. However, at the time Dr. Aldrich made the comparison he had a male of *major* before him and he redescribed the type, so there can be no doubt as to its identity insofar as the known species are concerned. It may be readily distinguished from both *major* and *majuscula*

by the presence of yellowish cilia on both lower edges of the posterior femora.

A complete description is given by Aldrich, but the female belongs to *varia*, new species.

***Calodexia major*, new species**

Male abdomen mostly reddish; femora reddish; middle tibiae with ventral bristle; female abdomen black above, with cinereous pollen. Length, 8 to 11 mm.

MALE.—Head black, densely white pollinose, the face yellow in ground color, the parafrontals with golden-yellow pollen that extends on to the parafacials and along the upper half of the posterior orbits. Front two-sevenths as wide as either eye; the reddish-brown frontal vitta linear; ten pairs of frontals, one situated below the base of the antennae, several of the upper ones more or less reclinate, the hair very fine and yellowish; ocellars minute. Occiput with pale yellowish hair, the black occipital cilia not extending below the lowest fourth of the eyes. Cheeks very narrow, with fine white hair and black bristles. Parafacials narrow and narrowing below. Proboscis reddish, the labellae and palpi yellow, the palpi with black hair. Antennae reddish yellow; arista brown with dull reddish base, very short plumose on the basal half.

Mesonotum and apical half of the scutellum ochreous pollinose, the mesonotum with four black vittae, the median pair replaced by a single stripe in front of the scutellum, all the vittae reaching rather close to posterior border and not interrupted at the suture. Scutellum blackish on basal half; three pairs of marginals, the apical pair entirely absent; acrosticals, 1-1; dorsocentrals, 2-3; three pairs of intra-alars. Pleura whitish pollinose, white-haired, the dorsum with black hair.

Coxae and femora reddish yellow, the femora darkened apically; anterior and middle coxae with considerable pale hair; the posterior femora with pale hair on most of their length posteriorly. Middle tibiae with a ventral bristle. Tibiae reddish brown, the tarsi black.

Wings with brownish-gray tinge. Squamae pale brownish with yellowish border. Halteres yellow.

Abdomen reddish, the pollen ochreous; a broad median blackish vitta extends from the base to the apex of the abdomen, expanding slightly toward the apex of the second segment, expanding on the third segment to occupy the apical third of the segment where it scarcely extends to the under surface, and again expanding to form a blackish or ferruginous apex of the fourth segment. On the second and third segments the pale pollinose fasciae cover about the basal fourth, expanding to encircle the discal bristles and expanding and becoming white on the under surface. The fourth segment is yellow pollinose on about the basal two-thirds. First and second segments each with pair of marginals, the third and fourth each with a row; second and third segments each with a pair of discals, the fourth with a row. Hair black except on the base of the under surface. Genitalia reddish.

FEMALE.—Very different in appearance from the male. Front half as wide as either eye, with almost parallel sides, but distinctly narrowed at the vertex, the parafrontals wider than the brown frontal vitta anteriorly but becoming narrower above; eight pairs of frontals, the upper two strong and reclinate; ocellars minute; outer verticals half as long as verticals. Mesonotal pollen cinereous yellow. Coxae without

pale hair, the middle pair brown; femora generally darker, usually broadly brown above on the whole length and on the broad apices, as well as sometimes on the bases, rarely as in the male, but the hair on the posterior femora similarly colored. Abdomen black, the pollen cinereous and not dense, on the second and third segments forming fasciae as in the male, the fourth cinereous pollinose on the whole surface, the pollen somewhat tessellate and on the second and third segments leaving a small black spot in the middle of the triangular expansion, this spot connected with the black of the posterior border by a narrow vitta. This marking is less obvious in the male but may be detected. The fourth segment bears a strong row of discs and a much weaker subapical row.

Types.—Holotype, male, and allotype, female, Barro Colorado Island, Canal Zone, December 23, 1928. Paratypes: one male and thirteen females, Barro Colorado, December 23, 25, 26, and 29, 1928 (Curran); male, La Suiza, Costa Rica (T. Schild); female, Cano Saddle, Gatun Lake, Panama, May 14, 1923 (R. C. Shannon). Paratypes in U. S. N. M.

Despite the difference in the color of the abdomen, there can be no doubt that the two sexes described here belong together, since the markings of the thorax and the chaetotaxy agree.

Calodexia majuscula Van der Wulp

VAN DER WULP, 1891, 'Biol. Centr. Amer.,' Dipt., II, p. 257 (f.). ALDRICH, 1929, Proc. U. S. N. M., LXXIV, Art. 19, pp. 21, 22.

Aldrich has redescribed this species in detail, basing his description on a specimen from Mexico, compared with the type by Major Austen. My description of the male of *major* will apply quite well, but the middle and posterior femora bear whitish cilia below, and the infrasquamal setulae are whitish. Van der Wulp's figure shows the median mesonotal vittae entire and not fused, but this may not be the case.

Calodexia agilis, new species

Black, the femora largely reddish; mesopleura black-haired; abdomen black-haired. Length, 6.5 to 7 mm.

FEMALE.—Head white pollinose, the upper half of the parafrontals and the upper part of the posterior orbits yellowish. Front a little more than one-third as wide as either eye, with almost parallel sides, narrowest at the vertex; frontal vitta blackish, much narrower than either parafrontal; seven or eight pairs of frontals, the upper two reclinate, the outer pair situated below the base of the antennae; ocellars absent; outer verticals strong. Occiput with pale yellow hair, the black occipital cilia extending to the lowest fourth of the eyes. Cheeks very narrow, with a row of black bristles. Parafacials moderately wide, strongly narrowed below. Proboscis reddish, the labellae and palpi yellow, the palpi with black hair. Antennae yellow, the basal segments somewhat darkened; arista brown with yellowish base, with conspicuous short rays on the basal third of the upper surface and short pubescence below.

Thorax cinereous pollinose, lightly tinged with yellow above. Mesonotum with four black vittae, the median pair united behind the suture and produced strongly

backward in the middle, thus forming a subtriangular spot that ends at about the same distance from the scutellum as the outer stripes. Scutellum with the base broadly brown, bearing three pairs of marginal bristles. Acrosticals, 1-1; three pairs of intra-alars. Hair black, partly fine and whitish on the pteropleura and sternopleura.

Anterior coxae wholly, the posterior pair mostly reddish, trochanters reddish yellow; femora reddish, the anterior pair brown above, middle pair reddish on the basal third except above and on the apical half of the under surface, the posterior pair reddish on the basal two-thirds and the apex; tibiae reddish brown, the tarsi black. Middle femora with two anterior bristles near the middle, their tibiae with a ventral bristle; anterior tibiae with three anterodorsal bristles.

Wings cinereous hyaline. Squamae whitish with the disc light brown. Halteres yellow.

Abdomen black, with cinereous pollen occupying a little more than the basal half of the second and third segments and expanding to occupy all but the apical fourth in the middle, in some lights reaching almost to the apex on the third segment; fourth segment pale pollinose and with a large, vertical brown apical spot on the lower half. First and second segments each with a pair of marginals, the third with a row; second and third segments each with a pair of discals, the fourth with a very strongly arched row and with two or three bristles along the sides of the genital opening. In the paratype the fourth segment is wholly pollinose. Hair black, only a very few pale hairs on the sternites.

TYPE.—Holotype, female, and paratype, female, Barro Colorado Island, Canal Zone, December 26 and 28, 1928 (Curran).

This species is very similar to *similis* Townsend but differs in the absence of ocellar bristles, wholly pale antennae, the presence of only three conspicuous anterodorsal bristles on the front tibiae, black-haired mesopleura, and almost wholly black-haired abdomen.

***Calodexia similis* Townsend**

Oestrogastroides similis TOWNSEND, 1915, Proc. U. S. N. M., XLIX, p. 425.

Two females, Barro Colorado Island, Canal Zone, December 23, 1928 (Curran).

The description of *agilis*, new species, will apply very well to this species with the following exceptions: there is a pair of small ocellar bristles; the third antennal segment is very broadly brown apically; the pleura are wholly white-haired; the anterior tibiae bear five or six conspicuous anterodorsal bristles in a row beginning near the base; there is a stronger row of bristles on either side of the genital opening, and the under surfaces of the basal abdominal segments are almost all pale pilose. In addition, the pollen has an ochreous tinge, but this character is probably not constant.

Calodexia insolita Curran

The description of this species is contained in a paper¹ dealing with Diptera from Kartabo, British Guiana.

Calodexia venteris, new species

Basal abdominal segments reddish with dark median vitta; pleura pale pilose; a transverse blackish fascia behind the suture. Male unknown. Length, 7 to 9 mm.

FEMALE.—Head white pollinose, the upper half of the front and the posterior orbits above with yellowish pollen. Front slightly less than half as wide as either eye, very slightly widening from the vertex to the anterior margin; six to eight pairs of frontals, the upper two reclinate, the anterior pair situated below the base of the antennae; two pairs of proclinate orbitals; ocellars short; outer verticals more than half as long as the verticals. Occipital pile white, the black cilia extending to the middle of the eyes. Cheeks very narrow, with a row of black bristles. Parafacials rather narrow, becoming very narrow below. Proboscis and palpi yellow or reddish yellow, the palpi with black hairs. Antennae yellowish, the third segment broadly tinged with brown apically; arista brown, long pubescent on basal third of upper surface and very short pubescent below, the base dull reddish.

Thorax cinereous pollinose, with more or less ochreous tinge. Mesonotum with four black vittae, the outer pair interrupted at the suture and extending to well behind the second posterior dorsocentral, the median pair fused behind the suture and very narrowly separated from the outer pair; in the middle replaced by a narrow grayish vitta extending toward the scutellum and only visible in certain lights. Scutellum with the base very broadly blackish, bearing three pairs of marginal bristles. Acrosticals, 1-1; anterior intra-alar very weak. Pleura and lower part of the humeri with whitish hair.

Coxae and femora reddish yellow, the apices of the femora brownish above; coxae with fine yellow hair, the femora wholly black-haired; tibiae reddish brown; tarsi black; middle tibiae with a bristle below.

Wings cinereous hyaline, with brownish tinge. Squamae whitish with brown disc. Halteres yellow.

First abdominal segment reddish, the median black vitta; second segment reddish with the apical half or less blackish, the black fascia not nearly reaching the lateral edges of the tergites except in rare cases, usually ending a little below the lateral margins of the abdomen, third segment blackish with the sides and venter usually broadly reddish basally; fourth segment blackish with about the lower half reddish yellow. Second segment with about the basal fourth cinereous pollinose, the pollen expanding strongly on the median third and occupying about the basal half on the under surface; third segment with more than the basal half pale pollinose, the pollen expanding in the middle and the apex of the segment usually bearing a pale pollinose median spot; fourth segment pale pollinose with the vertical apex broadly brown. From ventral view the abdomen appears reddish yellow with black fasciae on the posterior borders of the second and third segments, that on the third segment usually absent on the median half or more. Hair black, pale on the under side of the first segment. First and second segments each with a pair of strong marginals, the third

¹Curran, C. H., Amer. Mus. Bull., LXVI, Art 3, in press.

with a row, the fourth with finer bristles bordering the genital opening; second and third segments each with a pair of discals, the fourth with an arched row.

Types.—Holotype, female, Barro Colorado Island, Canal Zone, December 29, 1928. Paratypes: ten females, Barro Colorado Island, December 23, 29, 1928, and February 18, 1929 (Curran), and one female, November 20, 1930 (F. E. Lutz); 16 females, Barro Colorado Island, July 26, 1924 (N. Banks); one female, Higuito, San Mateo, Costa Rica (Pablo Schild).

Calodexia caudata, new species

Antennae and legs and sides of the abdomen reddish yellow; wings tinged with brown; fourth abdominal segment elongate and bearing three transverse rows of strong bristles. Length, about 11 mm.

MALE.—Head densely white pollinose, the frontal vitta brownish. Front one-fourth as wide as either eye, with almost parallel sides on the upper half, gently widening on the anterior half; eight pairs of frontals, one situated below the base of the antennae, the upper two strong and redinate and widely separated; ocellars very weak. Occiput white-haired, the black occipital cilia extending to somewhat below the middle of the eyes. Cheeks very narrow in profile, with fine white hair and a row of black bristles. Parafacials wide above, becoming linear below. Proboscis brown, the labellae and palpi reddish yellow, the palpi with short black hair above and pale hair below. Antennae reddish yellow; arista reddish brown, short plumose on the basal half.

Thorax black in ground color; mesonotum cinereous pollinose with a yellow tinge, with four black vittae, the median ones slender but expanded and fused behind the suture, the outer pair wider and interrupted at the suture, all ending far before the posterior border of the mesonotum. Hair and bristles black except on the outer edge of the humeri and the notopleural hairs. Pleura with white hair and black bristles. Acrosticals, 1-1; dorsocentrals, 3-3; three intra-alars; three pairs of marginal scutellars, the apicals absent.

Legs reddish yellow, the apices of the femora, the posterior tibiae and more or less of the bases of the femora, brownish; tarsi black. Hair black, the coxae with whitish hair, the posterior and middle femora with a row of short, rather dense ciliate yellow hair below.

Wings with brown tinge. Squamae whitish, with yellow border and yellow or fuscous tinge on the disc in some lights. Halteres yellow.

Abdomen brown, the two basal segments mostly reddish yellow. First segment brown basally, with a broad median vitta that expands posteriorly; second segment with somewhat more than the apical third and a rather narrow median vitta brown; third segment brown with a very broad, broadly interrupted basal reddish fascia. Pollen cinereous, dense, occupying almost the basal two-thirds of the second and third segments on the dorsum but narrowing laterally and ventrally, on the fourth segment covering the whole segment except the broad, brown pollinose apex and a narrow, incomplete median vitta. First and second segments each with pair of strong marginals, third and fourth each with a row; second and third segments each with a pair of discals, the fourth with two rows. Hair black, pale yellow on the under side of the first segment and on at least the basal sternites. Genitalia reddish.

HOLOTYPE.—Male, Cabima, Panama, May 18, 1911 (A. Busck), in U. S. N. M.

Calodexia apicalis, new species

Blackish; abdomen of male yellowish laterally; femora mostly reddish yellow; pleura black-haired. Length, 8 to 8.5 mm.

MALE.—Head white pollinose, the parafrontals and upper posterior orbits pale golden-yellow. Front two-sevenths as wide as either eye, narrowest in the middle, slightly widening above and below, the brown frontal vitta much narrower than either parafrontal; ten pairs of frontals, the upper two reclinate; ocellars very weak. Occiput with pale yellow hair, the black occipital cilia extending to the middle of the eyes. Cheeks very narrow, with a row of fine black bristles. Parafacials narrow, narrowing below, tinged with yellow on much of their length. Proboscis brown; labellae and palpi reddish yellow, the palpi with black hair. Antennae yellow, the basal segments more reddish; arista brown, almost bare, the base broadly yellowish.

Thorax cinereous pollinose, the dorsum with slight yellowish tinge. Black vittae in front of the suture reduced to narrow median stripes and a pair of spots, the post-sutural fascia entire but deeply emarginate above the wings. Scutellum with the base broadly blackish, bearing two pairs of strong marginals and a pair of apical hairs. Pile wholly black. Acrosticals, 1-1; anterior intra-alar very weak or absent.

Anterior coxae and the femora yellowish; anterior and posterior femora brown on the apical third, the middle pair on the apical half, the anterior femora pale on the whole length below; middle and posterior femora with rows of dense, short blackish hair on the apical half of both lower edges, the hair appearing golden brown in some lights. Middle tibiae with ventral bristle.

Wings cinereous hyaline. Squamae whitish, the disc tinged with brown. Halteres yellow.

Abdomen black and yellowish, with cinereous pollen. Second segment yellowish laterally, the black forming a posterior band that expands triangularly in the middle to reach the base broadly, and not reaching the lateral margins of the tergites; third segment yellowish on about the basal half laterally, the yellow bands tapering toward the middle of the dorsum and very widely separated; first segment mostly reddish below, the red color extending irregularly on to the dorsum. Pale pollen occupying about the basal fourth but expanding to one-half at the sides and to the apical fourth in the middle; pale pollen on third segment forming a broader basal band and similarly expanded; fourth segment pale pollinose with the apical third and more than the median third of the dorsum shining blackish. Hair entirely black. Genitalia reddish. First and second segments each with a pair of marginals, the third and fourth each with a row; second to fourth segments each with a pair of discals.

FEMALE.—Front half as wide as either eye, narrowest anteriorly; seven or eight pairs of frontals and two pairs of orbitals; parafrontals white on anterior half, yellowish above. Abdomen blackish, with cinereous-white pollen arranged as in the male, the chaetotaxy similar except that the apicals on the fourth segment are weaker. From ventral view the abdomen appears partly brownish red.

Types.—Holotype, male, allotype, female, Barro Colorado Island, Canal Zone, December 25, 29, 1928 (Curran). Paratype, male, Barro Colorado, May 13, 1926 (C. T. Greene), in U. S. N. M.

The paratype differs from the types in having the black postsutural fascia entirely interrupted above the roots of the wings.

Calodexia panamensis, new species

Black, with cinereous pollen; legs black; acrosticals, 2-3. Length, 4.5 to 7 mm.

MALE.—Front three-tenths as wide as either eye; parafrontals golden-yellow pollinose, about as wide as the brown frontal vitta; eight to eleven pairs of frontals, the lowest sometimes arising below the base of the antennae, the upper two strong and reclinate; ocellars very weak. Occiput yellow above, becoming cinereous pollinose below; black orbital cilia extending to, although weak just above, the cheeks; hair white. Cheeks very narrow, with fine black hair and bristles. Parafacials narrow and narrowing below. Proboscis brownish, the labellae and palpi reddish or reddish yellow; palpi with black hair apically. Antennae reddish, the third segment mostly brown; arista brown with reddish base, long pubescent on the basal half.

Mesonotum with ochreous or cinereous-yellow pollen, with four brown vittae, the median pair fused behind the suture where the stripes are only narrowly separated from the outer ones which are wide, interrupted at the suture, and extend well toward the scutellum. Hair and bristles black. Pleura with cinereous pollen and black hair. Acrosticals and dorsocentrals, 2-3; anterior intra-alar hairlike. Scutellum blackish basally, the apex concolorous with the mesonotum; three pairs of marginals and a pair of weak, divergent apicals.

Legs brown, the trochanters reddish; coxae cinereous pollinose and with black hair; middle tibiae with ventral bristle. Hair wholly black.

Wings with brown tinge. Squamae with brown tinge, the border and base yellow. Halteres yellow.

Abdomen brown and yellowish, the pollen yellow dorsally, becoming white ventrally. First segment brown, with indications of an interrupted preapical yellowish fascia dorsally, the under side becoming mostly yellow. Second segment yellowish with about the posterior half brown on the dorsum, the brown fascia tapering and not reaching the lateral edges of the tergites; third segment similar to the second but the brown band is wider dorsally and almost reaches the edges of the tergites on the under surface. Second and third segments with the basal third dorsally, expanding on the under surface. pale pollinose; fourth segment pale pollinose on the basal two-thirds. First and second segments with pair of marginals, the third and fourth with a row; second and third segments with pair of discals, the fourth with a row.

FEMALE.—Front about half as wide as either eye, white with yellowish tinge, the frontal vitta brown and about as wide as either parafrontal; seven to nine pairs of frontals; two pairs of orbitals; outer verticals developed but short. Occiput with yellow tinge on upper half. Thorax and scutellum more cinereous pollinose. Squamae whitish with only the disc tinged with brown. Abdomen blackish brown, the apices of the tergites yellowish on the under surface. Pollen cinereous, occupying about the basal third toward the middle of the second and third segments but triangularly expanded in the middle to reach almost to the apical fourth and expanded on the under surface to occupy the basal three-fourths. Fourth segment pale pollinose except the broad border surrounding the genital opening which is entirely ventral. Fourth segment bearing two rows of bristles, one on the basal third and the second forming an apical arch.

TYPES.—Holotype, male, allotype, female, Barro Colorado Island, Canal Zone, December 22 and 23, 1928. Paratypes: male and female, same data; two females, Clooses, Cano Saddle, Canal Zone, May 2, 1923 (R. C. Shannon); male, Tabernilla, Canal Zone, (A. Busck) in U. S. N. M.

Calodexia bequaerti, new species

Very similar to *panamensis*, new species, but readily distinguished by the darker antennae. Length, 5 to 5.5 mm.

FEMALE.—Head cinereous-white pollinose, the parafrontals tinged with yellow on the upper half, the posterior orbits with yellowish tinge above. Front about half as wide as either eye, the blackish frontal vitta slightly wider than either parafrontal; eight pairs of frontals, the anterior pair situated below the base of the antennae, the upper two pairs reclinate; two pairs of orbitals; ocellars rather short; outer verticals half as long as verticals. Occiput pale yellowish pilose, the black occipital cilia extending to the cheeks. Cheeks very narrow, with a row of black bristles. Parafacials very narrow and narrowing below. Proboscis brown, the labellae and palpi reddish yellow, the palpi with black hair. Antennae black, the basal segments brownish, the incisure between the second and third segments reddish.

Thorax black, with cinereous pollen; mesonotum with four black vittae, the median pair united behind the suture. Scutellum black on the basal half, with four pairs of marginals the apicals weak. Acrosticals, 2-3; anterior intra-alar weak. Hair wholly black.

Legs black; middle tibiae with bristle below; middle femora with two anterior bristles near the middle.

Wings cinereous hyaline, sometimes with brownish tinge. Squamae pale brownish, the rim and broad base white. Halteres pale yellow.

Abdomen black, with cinereous-white pollen. Second segment pale pollinose on a little less than the basal half above, the pale band expanded triangularly in the middle to reach the apex of the segment, and broadened on the under surface; third segment similarly pollinose; fourth segment pale pollinose, the pollen with brown tinge between the arched row of discals. First and second abdominal segments each with a pair of marginals, the third with a row; second and third segments each with a pair of discals, the fourth with an arched row of discals, a secondary row composed of four bristles within the arched row, and with weak bristles along the sides of the genital opening. Hair wholly black.

TYPES.—Holotype, female, and paratype, female, Moca Guatalon, Guatemala, 1000 m., March-April, 1931, and female paratype, Santa Emilia, Pochuta, Guatemala, February-March, 1931 (J. Bequaert).

This species has the pollen of the head much duller than *panamensis*, which has shining whitish pollen in the female, and the females appear to be slightly larger.

Calodexia valera, new species

Rather similar to *panamensis* but the abdomen is much less yellowish, the anterior intra-alar is strong, etc. Length, 8 mm.

MALE.—Head white pollinose, the parafrontals with yellow tinge or yellowish; front scarcely half as wide as either eye, the frontal vitta brown; ten pairs of frontals, one below the base of the antennae, the upper two strong and reclinate; ocellars missing. Occiput with white hair, the black occipital cilia extending to the cheeks. Cheeks very narrow, with black hair and bristles. Parafacials narrow and narrowing below. Proboscis brown, the labellae reddish; palpi reddish yellow. Antennae reddish, the third segment mostly brown; arista brown, long pubescent basally.

Thorax cinereous pollinose, the mesonotum with four blackish vittae that unite behind the suture to form a rectangular, transverse bar that is widest in the middle and is slightly produced posteriorly at the outer corners. Scutellum brown with the margin broadly cinereous; four pairs of marginals (the apical pair broken off, but not stronger than the second pair). Acrosticals, 3-3; dorsocentrals, 2-3; three pairs of intra-alars, the anterior pair strong although weaker than the following ones. Hair wholly black.

Legs blackish; middle tibiae with a ventral bristle; coxae cinereous pollinose and bearing black hair; trochanters reddish. Hair wholly black.

Wings with brown tinge. Squamae light brownish, with pale border. Halteres yellow.

Abdomen brown, the sides of the second and third segments broadly yellow in ground color. First segment brown; second with the basal third yellowish at the sides, narrowing toward the middle of the dorsum and toward the ventral, lateral margins; third similar, but the yellow does not extend so far on to the dorsum. Pollen cinereous, covering the yellow ground on the second and third segments and extending entirely across the base of the segment on the basal third or fourth, the posterior portions of the segments brown pollinose. On the fourth segment the pale pollen occupies about the basal third. First and second segments with pair of marginals, the third and fourth each with a row; second and third segments with pair of discals, the fourth with a row. Hair entirely black.

HOLOTYPE.—Male, Valera, Venezuela, in U. S. N. M.

While this species is close to *panamensis* it is undoubtedly distinct because of the differences in color and chaetotaxy.

***Calodexia varia*, new species**

Black, with cinereous pollen, the abdomen partly irrorate with dark spots; three pairs of postsutural acrosticals. Length, 8 mm.

FEMALE.—Head whitish pollinose, the parafrontals and upper part of the posterior orbits with ochreous tinge. Front about half as wide as either eye, narrowest anteriorly, the sides distinctly convex; frontal vitta black, narrower than either parafrontal; about eight pairs of frontals, the upper two reclinate, the lower one or two situated below the base of the antennae; ocellars well developed; outer verticals three-fourths as long as the verticals. Occiput with pale yellowish pile, the black occipital cilia extending to the cheeks. Cheeks narrow, with a row of black bristles. Parafacials narrow, tapering below. Proboscis brown; labellae yellow; palpi roddish yellow, their hair mostly black. Antennae brown, the base of the third segment broadly reddish, the basal segments brownish red; arista brown, with reddish base, very short plumose on the basal third.

Thorax cinereous pollinose, the dorsum rather ochreous. Mesonotum with four black vittae that extend almost to the scutellum, the median ones replaced on the posterior fourth by brown. Scutellum not black basally, with three pairs of marginals. Acrosticals, 1-3; three strong intra-alars. Hair wholly black.

Legs black, the trochanters and the knees very narrowly, reddish; middle femora with two anterior bristles near the middle; middle tibiae with ventral bristle.

Wings cinereous hyaline, with slight brown tinge. Squamae whitish with the entire disc of the lower lobe pale brown. Halteres yellow.

Abdomen black, with cinereous pollen. On the second and third segments the pale pollen extends to the marginal bristles and is irrorate with shining black spots on the dorsum that tend to fuse on the disc; fourth segment wholly pale pollinose, the bristles arising from darker spots; first segment with some pale pollen on the disc. First and second segments each with a pair of marginals, the third with a row; second and third segments each with a pair of discals, the fourth with a strong, arched row. Hair wholly black except on the basal sternites.

HOLOTYPE.—Female, Barro Colorado Island, Canal Zone, December 23, 1928 (Curran).

This is the species described by Dr. Aldrich as the female of *flavipes* Schiner (Proc. U. S. N. M., LXXIV, Art. 19, p. 23).

***Calodexia mexicana* Townsend**

Oestrogastropsis mexicana TOWNSEND, 1915, Proc. U. S. N. M., XLIX, p. 424.

I have no representatives of this species before me but I have examined the type. The species is somewhat similar to *varia* but has two pairs of presutural acrostical bristles.

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NEW SPECIES OF CARABIDAE FROM PUERTO RICO

By ANDREW J. MUTCHLER

The following new forms of Carabidae from Puerto Rico form part of the series collected during the Survey of the island, which was carried on by the New York Academy of Sciences in coöperation with the Puerto Rican government and this Museum. It was originally intended to include descriptions of these new species in the report on the Survey, but Dr. P. J. Darlington, who is making a study of the carabid fauna of Cuba and other islands of the West Indies, suggested that they be published in advance, so that he might include them in his records, which he hopes will contain all of the described forms of Carabidae from the West Indies.

In connection with this work Dr. Darlington has made several helpful suggestions as to certain species in the Puerto Rican material. He also has loaned to this Museum several Cuban and other forms for comparison. Of these, two species were found to be the same as the Puerto Rican forms described herein. They have been included as paratypes and, except for two examples of each, were returned to the Museum of Comparative Zoölogy. The types of all are in the American Museum Collection.

Scarites montanus, new species

Dull black with only front of head and mandibles shining, parallel, strongly pedunculate. Head quadrate, with two deep longitudinal fossae in front, numerous longitudinal wrinkles on the disk not reaching the base which is finely and closely punctured. Mandibles large, curved at apex, sharply pointed, truncate at outer margin, bluntly toothed within, broadly expanded at base, upper surface with a few longitudinal wrinkles. Antennae brownish, basal joint long, next two elongate, shining, outer joints pubescent and becoming slightly broader toward apex. Pronotum quadrate, transverse; subapical and longitudinal median lines impressed; front, between the suture and transverse line, longitudinally wrinkled; disk with fine lines branching from the longitudinal line, otherwise appearing very finely granulate and with wavy lines that are more noticeable apically (the above discal characters are not visible to the naked eye), hind angles broadly rounded. Elytra parallel, conjointly rounded at apex, surface dull, finely striate, striae not quite reaching the apex or base, intervals flat. The third stria of the left elytron has five large punctures on the disk, and the right elytron has six punctures. Both elytra have two punctures

at the declivity of the apex, sub-basal and sublateral margins granulate, humeri prominent and somewhat suddenly declivous behind the angles. Body beneath piceous; head, thorax, and legs shining; abdomen dull, sides of the two apical segments with a somewhat large pale reddish spot approximate to the lateral margin; legs fossorial, anterior tibiae externally with three sharp teeth, tibiae slightly paler than the femora, tarsi still paler. Length, 17 mm.

TYPE.—El Yunque, Puerto Rico, February 21, found under a stone on the mountain, by C. W. Leng.

This species may be the *Scarites subterraneus* Fabricius recorded by Stahl, 1882, 'Fauna de Puerto Rico,' p. 170, which appears also in subsequent lists. It bears a certain resemblance to the Fabrician species, differing, however, especially in the elytral punctures.

It has been noted in the above description that the punctures on the elytra differ in respect to the number on each. This difference no doubt is abnormal, but it is reasonable to believe that one or the other series must be present on the elytra of normal specimens. It also seems probable that the five punctures on the left elytron are more likely to be normal, as they are in regular formation, each being the same distance apart. Those on the right elytron are arranged differently: one and two closer to each other, two and three farther apart, three and four closer, four and five farther apart, five and six farther apart. The first or basal puncture and the two punctures at the apex of one elytron are directly opposite the corresponding ones on the other elytron.

***Dyschirius coamensis*, new species**

Shining, reddish, prothorax globose. Head smooth, with a short groove each side in front; mandibles and palpi long, sharply pointed; antennae with first and second joints elongate, from third on, somewhat moniliform. Pronotum rounded at sides and hind angles, front angles obtuse, median groove somewhat fine apically but becoming deeper basally and extending from the apical transverse groove almost to the basal margin. Elytra rounded at sides and humeri, distinctly margined, striae apparently not raised, punctation consisting of what appears to be smooth reticulations arranged in rows. A small bristle-bearing puncture on the basal fourth, in the third series of the reticulation, and another on the same series, behind the middle (both of the punctures distinguishable only under somewhat high power magnification). Under surface smooth, shining; front tibiae with two small teeth on the outer margin, front angles very much prolonged and ending in a somewhat sharp, curved tooth. Length, 2 mm.

TYPE.—Coamo Springs, Puerto Rico, February 11, 1928, collected on the sandy shore of a small brook, by C. W. Leng.

***Bembidion darlingtoni*, new species**

Slightly convex, piceous, shining, with the mouth-parts and three or four joints of the antennae testaceous, other joints of antennae slightly darker. When viewed from above the outer joints of the antennae appear darker than from below; elytral markings variable. The type has a basal yellow area that extends from the base to beyond the apical half but does not reach the scutellar area or lateral margin; behind the middle is another yellow area that extends to the sides but not to the suture, and connected with this at the lateral margin is an apical pale spot. In other specimens the basal pale spot extends to the scutellar area and the apical spots are broadly connected, appearing as a more or less elongate, pale space. In two specimens the pale areas appear as nebulous clouds; under surface pitchy black. Head smooth, shining, not in the least coriaceous. Pronotum cordate, about one-fourth wider than long, noticeably broader at apex than at base, median line fine, transverse impression moderately deep, side margins reflexed. Elytra about one-half wider than the pronotum at base, punctate-striate, all but the complete sutural stria becoming more or less effaced at base, third interval with one large puncture about one-third from base and one on the apical two-thirds. Legs more or less testaceous, but in some specimens with a darker space at middle of one or more pairs of the femora. Length, 3.5 mm.

Types.—Type, Ensenada, Puerto Rico, June 15, and one paratype, Caguas, Puerto Rico, May 28; nine paratypes, Soledad, Cuba, June and October, collected by P. J. Darlington. Two of the latter have been donated to the American Museum.

In addition to the above there is in the American Museum collection a broken specimen from Lake Categena, Puerto Rico, February 28, collected by Dr. S. Danforth.

This species is similar to *B. affine* in many respects, but one noticeable difference, which seems constant, is that the new species has the head impunctate, whereas in *B. affine* the head is finely punctate, a character not mentioned in the descriptions but which appears to be constant in the large series of specimens in the American Museum Collection.

***Tachys ensenadae*, new species**

Oblong, parallel, testaceous; head and pronotum in great part dark brown, but often with the darker color subvittate in character. Head and pronotum finely and closely punctulate. Elytra with dorsal, two subsutural, and sutural striae more plainly indicated in some specimens than in others. The recurved portion of the sutural stria is C-shaped and encloses at its extremity a bristle-bearing puncture; the outer subsutural stria is interrupted at the middle with a bristle-bearing puncture; the submarginal stria is broadly interrupted at the middle. The elytral markings are variable on each elytron; the suture is dark brown, as is a narrower marginal area, leaving between this area and the suture an irregular, nebulously limited testaceous vitta. This vitta, which is usually broader in the subhumeral and subapical regions than at the middle, is partly transparent and, in a bright light, portions of the under wing may be detected beneath. The darker specimens are more distinctly vittate than the paler ones. Length, 2.25 mm.

Types.—Type, Ensenada, Puerto Rico, June 14–19, one paratype, Arecibo, Puerto Rico, June 25, collected by Lutz and Mutchler; ten paratypes, Vieques Island, April 20, collected by M. D. Leonard.

In some specimens the head and pronotum are almost totally dark, merely showing traces of the paler color, also the outer joints of the antennae appear slightly darker than the basal ones. The pale area on the elytra in some specimens becomes quite narrow; in others it is entirely obliterated at the middle, leaving only a pale area at the apex and base. The outer subsutural stria in some cases is not as well indicated as the inner and sutural ones, and in others both of the subsutural striae are more or less obliterated.

The specimens from Ensenada were collected on an alkali flat, near Lake Guanica. Most of them were taken by sifting a windrow of débris which consisted mostly of cow dung. There are eleven specimens in the lot in which the color is apparently undeveloped. In these, the head is fuscous; antennae, pronotum, legs, and body beneath, except abdomen, testaceous. The under wings and parts of the dorsum can be seen through the yellowish semitransparent elytra: because of this the elytra appear to have a broad triangular dark spot at the scutellum and other dark markings where the sides of the dorsum show through. There are also four specimens, similar to the above, from Vieques.

Pseudaptinus (Thalpius) insularis, new species

Rufo-testaceous, head wholly or in part dark brown, almost black, elytra dark reddish-brown, pronotum in some specimens with a dark brown patch at apex and sometimes slightly darker at base. Head transverse, separated from the prothorax by a broad neck, closely punctate, pubescent. Eyes large, prominent. Antennae short, first joint elongate, but shorter than the head, succeeding joints bead-like. Maxillary palpi with last joint enlarged; labial palpi simple. Pronotum truncate at apex, a little wider than the head, sinuately narrowed behind, hind angles prominent, surface finely punctate, pubescent. Elytra a little wider than the prothorax, parallel, subtruncate at apex, striate, intervals finely punctate, pubescent. Under surface finely and closely punctate and covered with a short pubescence. Claws simple. Length, 4.5 mm.

Types.—Type, Mayaguez, Puerto Rico, September 22, 1916, collected by R. H. Van Zwaluwenburg. Eighteen paratypes: one, Mayaguez, Puerto Rico, May 11, 1917, collected by R. H. Van Zwaluwenburg; seventeen specimens, Soledad, Cienfuegos, Cuba, October 21 to November 3, 1926, and June 1929, collected by P. J. Darlington. All but two of the Cuban paratypes are in the collection of the Museum of Comparative Zoölogy.

***Selenophorus puertoricensis*, new species**

Aeneous, greenish to coppery on the pronotum, coppery on the elytra, antennae dark fulvous, three or four basal joints in part darker, other joints with a dark line longitudinally along the middle, palpi and labrum fulvous, mandibles dark at base and apex, slightly paler at middle. Head quadrate, smooth, with three foveolae in a transverse row in front of the eyes and faintly connected by a vague depression. Pronotum wider than long, slightly narrowed at base, sides rounded anteriorly, oblique behind, front angles rounded and protruding forward, middle of apical margin almost straight, hind margin slightly sinuate, angles obtuse, rounded, surface polished, median sulcus incomplete, slightly impressed, base punctulate (under high power the whole surface appears finely punctulate, but the punctures on base are closely grouped), the group of punctures extending farther apically on the sides than on disk. Elytra parallel, humeral angles acute, apex sinuate, striae entire, intervals flat, with a row of more or less distinct punctures on the third and fifth lateral (these punctures are located approximate to the second and fifth striae), ninth interval broken apically and basally by large depressed punctures, leaving a section behind the humeri and extending to the middle entire. Under surface and legs ferruginous, basal joint of hind tarsi approximately equal to the next two taken together. Length, 10-11 mm.

Types.—Type, Desengano, Puerto Rico, December 1, collected by W. T. M. Forbes; paratype, Manidos, Puerto Rico, March 17, collected by W. M. Wheeler.

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THE "ARGILES FISSILAIRES," A SERIES OF OPAL-BEARING ROCKS OF PATAGONIA¹

By G. C. McCARTNEY

In an earlier paper² by the writer, a detailed description of the petrology of the mammal-bearing rocks of Patagonia was given. These rocks were found to be, in the main, bentonites, bentonitic ashes and volcanic ashes. During the course of this study the need for further study of more of the closely related rocks became apparent. The rocks described in the present paper have been referred to as the "Argiles fissilaires" and generally underlie the main mammal-bearing Casamayor Formation.

The writer wishes to thank Professor P. F. Kerr of Columbia University for his coöperation in making and interpreting the X-ray analyses of the rocks described in this paper.

³Ameghino gave the name "Argiles fissilaires" to non-fossiliferous rocks underlying the *Notostylops* Beds south of Punta Casamayor. He intended by this name to designate a type of rock, rather than a particular formation, yet he generally applied it only to rocks at about this horizon, and it has come to be used in the literature almost like a formation name.

It is of great importance in an interpretation of the stratigraphic relations to know whether the "Argiles fissilaires" are distinct from the *Notostylops* Beds or Casamayor Formation or whether they represent a part of a more or less continuous series and should be included as a part of the Casamayor.

The "Argiles fissilaires" rocks are lithologically quite different from the soft bentonitic rocks which form the main part of the *Notostylops* Beds, for they are hard, flint-like rocks which form prominent ledges due to the tendency for them to resist erosion to a greater degree than do the bentonitic rocks. If the "Argiles fissilaires" rocks are different not only lithologically but also genetically from the typical Casamayor, then it would be in order to regard them as comprising a distinct formation.

¹Publications of the Searritt Expedition, No. 20.

²McCartney, G. C. 1933. 'The bentonites and closely related rocks of Patagonia.' Amer. Mus. Novitates, No. 630.

³Ameghino, F. 1906. 'Les formations sédimentaires du Crétacé supérieur et du Tertiaire de Patagonie.' An. Mus. Nac. Buenos Aires, XV [(3) VIII], pp. 1-568. [Argiles fissilaires, especially p. 103.]

Detailed petrographic study together with X-ray and chemical analyses reveals the fact that the "Argiles fissilaires" rocks have a very close genetic relationship to the Casamayor Formation and that the reason for the difference in lithologic character of the two rock types is that the so-called "Argiles fissilaires" represent zones or beds along which there have moved silica-bearing solutions and these solutions have brought about replacement of the rock itself by an opaline material. The result of the replacement by opaline material is a rock which is very thoroughly cemented, very hard and highly resistant to weathering forces.

The characteristic "Argiles fissilaires" rock of Ameghino from what may be considered the type locality, below the type Casamayor at the mouth of Cañadón Lobo (Cañadón Tournouer of Ameghino), is described in detail in the following paragraphs—No. 148. Beds almost identical in character and position occur along the escarpment bounding the Cuenca de Sarmiento on the south, and at various points inland in northern Santa Cruz territory.

No. 148

FIELD OBSERVATIONS.—[This and other statements recorded in this paper which have to do with observations in the field are taken from the field notebook of Dr. G. G. Simpson, the leader of the Scarritt Patagonian Expedition.]

The rocks are very distinctive, being composed of very hard flinty material in beds from one to several feet in thickness alternating with softer rocks (bentonites) and usually more brightly colored than the overlying rocks (the so-called *Notostylops* Beds). The hard beds may, as in this instance, be gray when unweathered, but they are often, especially when weathered, colored or mottled bright yellow, orange or red. The presence of innumerable small limonitic nodules in places is also characteristic.

The most outstanding feature displayed by specimens of these "Argiles fissilaires" rocks is their great hardness. The rocks are very fine in grain size, homogeneous in texture, and break with a conchoidal fracture.

PETROGRAPHIC STUDY.—Thin section shows the rock to be composed of a mosaic of very small fragments. The fragments are fairly uniform in size and tend to be rectangular or square in shape; they exhibit the properties of volcanic glass and at first one is led to believe they are composed of volcanic glass. It has been found that these fragments

represent original fragments or shards of volcanic glass which have been replaced by silica. The silica is present in the form of opal. The matrix of the fragments is colored a dirty green and evidently represents an impure opaline material. There is a small quantity of micaceous material through the rock. In addition the rock contains many very small fragments of quartz and a few of chalcedony. Fig. 1A is a photomicrograph of the rock. The abundance of fragments or shards is readily seen; rectangular, square, and wedge-shaped pieces are most common. The matrix of the fragments is an impure opaline material.

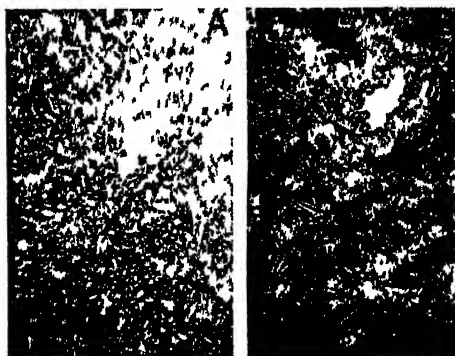


Fig. 1.—Thin sections of the “Argiles fissilaires.” A, Typical of the rock, from Cañadón Lobo, specimen No. 148. B, Typical of the rock, from Cañadón Hondo, specimen No. 75. Ordinary light. Magnified about eighty diameters.

Since the rock represents the “Argiles fissilaires” from the type locality it was considered to be of sufficient importance to warrant a very detailed study. In order to make the study conclusive both a chemical and an X-ray analysis were made.

The following table gives the results of a complete chemical analysis of the rock. The analysis was made by F. A. Gonyer of Harvard University:

SiO ₂	86.92	K ₂ O	.20
TiO ₂	.31	H ₂ O—	1.52
Al ₂ O ₃	4.84	H ₂ O+	4.39
Fe ₂ O ₃	.82	CO ₂	none
FeO	.15	P ₂ O ₅	none
MnO	none	SO ₃	none
MgO	.04	BaO	none
CaO	.12	ZrO ₂	none
Na ₂ O	.57		99.88

The chemical analysis shows the rock to be remarkably high in silica. Next to silica, alumina is the most abundant constituent but even this constituent is not present in sufficient quantity to be of any importance. There is not sufficient base present to make one of the clay minerals and probably not a definite mica. The analysis indicates rather clearly that the rock is composed essentially of opal, plus small amounts of impurity. The lack of any appreciable quantity of sodium indicates that the original volcanic glass fragments have been completely replaced by other material, in this instance by silica in the form of opal.

The diffraction pattern obtained from an X-ray analysis of the rock reveals the fact that it is not a pure opal rock. Pure opal does not give a diffraction pattern; this material, however, does yield a few lines. The presence of a few lines in the pattern suggests very strongly that the material making up the rock is a mixture of materials such as chalcedony, quartz, micaceous material and iron oxide.

Another interesting rock which is considered to form a part of the "Argiles fissilaires" is found in the vicinity of Cañadón Hondo. It is, as in the case of No. 148, a very hard rock which breaks with a conchoidal fracture. This rock differs from No. 148, however, in that it is green in color instead of light gray.

Nos. 74 and 75

FIELD OBSERVATIONS.—These rocks represent the harder strata of a series which closely resembles the recognized "Argiles fissilaires" in its topographic expression and most of its physical characters, but differs in color. Both the hard beds and the bentonites are green or blue-green, generally rather pale, whereas the typical "Argiles fissilaires" are generally gray or yellowish when unweathered. Furthermore, fossil mammals, apparently of Casamayor age, were found in this series, whereas none have ever been found in the typical "Argiles fissilaires." Laboratory confirmation of the field impression that these are really essentially similar to the recognized "Argiles fissilaires" is therefore of great importance.

PETROGRAPHIC STUDY.—In this instance the rock has a very pronounced development of shard structure. The shards are often long stem-like forms which sometimes branch to give Y-shaped or three-pronged individuals. The shards in this rock differ very greatly in shape from those in the No. 148 rock. The Y-shaped shards in this rock look very like sponge spicules and could easily be mistaken for spicules. There is sufficient difference between the shape of the shards in the two

rocks to suggest that they may represent separate ash falls, which is in any case highly probable from the field data. The groundmass of the rock is composed essentially of a dirty green-colored impure opaline material. This rock differs from the first "Argiles fissilaires" rock described, in that there is a much greater development of chalcedony in the present instance. The rock was originally fairly porous but the pores have since been filled by chalcedony. Many of the shards, too, have been filled with chalcedony. In the cavities and in many of the shards, the central part is filled with chalcedony and the outer part is composed of opaline material. In such instances the opaline material forms a globular-shaped border zone around the chalcedony. This structure is often very pronounced and is made evident due to the refractive index of the impure opal being considerably greater than that of the chalcedony.

Fig. 1B is a photomicrograph of rock No. 75. A number of the spicule-like shards are visible in the picture. The contrast in the shape of the shards in the No. 148 and the No. 75 rocks is well illustrated in Figs. 1A and 1B. Fig. 1B also illustrates a chalcedony-filled cavity with its globular-shaped border zone of impure opal.

Of minor importance as constituents of the Nos. 74 and 75 rocks there are a very few fragments of quartz and plagioclase. There is a rather extensive development of micaceous material, which is at least in part montmorillonite and some of which shows the structure of the parent volcanic glass.

X-ray analyses of Nos. 74 and 75 give patterns very similar to that of No. 148. No. 75 gives a pattern which suggests a mixture of a number of different materials, e.g., chalcedony, quartz, montmorillonite, other micaceous minerals, etc., in fact the pattern of No. 75 suggests a greater mixture of materials than do any of the other "Argiles fissilaires" rocks. However, the pattern of Nos. 74 and 75 is so nearly like that of No. 148 that it is in order to say that these rocks, too, are composed essentially of opal plus some impurity.

In order to establish definitely the genetic relationship between rocks considered to be "Argiles fissilaires" and the bentonitic rocks as in the Casamayor, for example, a study was made of specimens taken from an outcrop in which the two rock types are intimately associated. Specimens numbered 1-5 are taken from the "Argiles fissilaires" exposed in a cliff south of Lago Colhué Huapí.

Nos. 1 to 5

FIELD OBSERVATIONS.—In this locality the “Argiles fissilaires” are closely similar to those of Cañadón Lobo both in appearance and in stratigraphic position. They form a series of horizontally banded but lenticular beds about 115 or 120 feet thick beneath the mammal-bearing ashes and bentonites of the characteristic Casamayor Formation. The beds of the “Argiles fissilaires” series are highly heterogeneous, consisting of alternating hard ashy or opaline beds and softer clay-like bentonites. They are often very brilliantly, but for the most part superficially, colored, the hard beds, especially, being mottled red, yellow, and orange. The contact with the overlying softer, more homogeneous, and paler mammal-bearing beds is gradational, the clay-like strata becoming thinner toward the top and the hard layers thinner and less frequent. Rocks Nos. 1–4 represent the range of variation of the general “Argiles fissilaires” series, while No. 5 represents the highest hard bed, intercalated in the Casamayor bentonites, which are here highly gypsiferous.

No. 1. The rock is cream- and buff-colored, is quite hard and contains nodules of brown-colored iron oxide. It has a distinct gritty or ashy feel. In thin section the rock is seen to consist of a light-green-colored material. High magnification shows this material to be made up of volcanic glass fragments in a matrix of material of similar nature though not so distinctly fragmental. The glass fragments or shards are usually rectangular in shape and are similar in size and shape to those illustrated in Fig. 1A. Fragments of quartz are very common. A few fragments of feldspar (oligoclase) are present. Chalcedony appears as a cavity-filling material; it is, however, not abundant. Montmorillonite is developed on a small scale.

The rock is volcanic ash.

No. 2. This rock is similar macroscopically to No. 1. Petrographic examination reveals the presence of many rectangular and square-shaped glass fragments similar to those in Fig. 1A. These fragments are even more abundant than in rock No. 1.

No. 3. This specimen is light red in color, is soft and swells and falls apart when placed in water. It differs from Nos. 1 and 2 in that the matrix is made up of the mineral montmorillonite. High-power magnifi-

cation shows the presence of a shard structure similar to that in Nos. 1 and 2 and illustrated in Fig. 1A, but in this instance the shards are not abundant.

Fragments of quartz and oligoclase are fairly common constituents of the rock. The X-ray diffraction pattern agrees very closely with that given by montmorillonite.

The rock is bentonite.

No. 4. No. 4 is very similar both macroscopically and microscopically to No. 1.

No. 5. There is a great similarity between this specimen and No. 2. Iron oxide nodules are common in the rock. With low-power magnification the rock appears opaque in thin section; high magnification shows the opaque material to consist very largely of fragments which are very like volcanic glass and very like those shown in Fig. 1A. Oligoclase feldspar fragments are quite common constituents of the rock.

X-ray analyses of this series of rocks give further information of value. The X-ray diffraction patterns of specimens Nos. 2 and 5 agree very closely with that of No. 148. It is clear from X-ray study that these rocks, like No. 148, have been very greatly changed by the addition of material and that the rocks have been thoroughly replaced by silica in the form of opal. No. 3 gives a diffraction pattern similar to that of montmorillonite; the rock is an excellent bentonite. Rocks Nos. 1 and 4 are typical volcanic ashes in which there has been little alteration either to bentonite or to opal.

Since specimens Nos. 1-5 represent a series of rocks which are intimately associated in the field and since the series includes volcanic ashes, bentonites and rocks of the characteristic "Argiles fissilaires" type, i.e., opal-bearing rocks, it would seem that these rocks should furnish valuable information concerning the genetic relationships which exist among the rocks as a whole. The close association in the field suggests very strongly a common source of origin for the three main rock types, i.e., the volcanic ashes, the bentonites and the opal-bearing rocks. The close association of volcanic ash and bentonite is a very common feature in the mammal-bearing rocks of Patagonia.¹ The association of opal-bearing rocks with volcanic ashes and bentonites seems to be quite in order, for in every instance the opal-bearing rocks are found to be made up largely of fragments of material which are similar in size and shape to

¹McCartney, G. C., op. cit., p. 1.

the fragments of volcanic glass found in the ash and bentonite rocks. X-ray and chemical analyses both show that the opal-bearing rocks contain a very high percentage of opal and that the original glass fragments have been replaced by opal.

At first it was considered that the great difference in shape between the shards of the Nos. 74 and 75 type—illustrated in Fig. 1B—and those of No. 148 and Nos. 1–5 type—illustrated in Fig. 1A—indicated different ash falls and that the reason for the silicification of certain horizons might be referred to ash falls of different character and composition originally. The contrast in shape of the shards does suggest different ash falls, but there is little reason to believe that any relation exists between the character of the original ash fall and the silicification of the rocks, for both types of ash rock have been thoroughly replaced by opal.

It seems to the writer that the facts presented in this paper lead to some rather important conclusions, especially in regard to an interpretation of the stratigraphic relations of the rocks in the field.

1. The so-called “*Argiles fissilaires*” and the volcanic ashes and bentonites are a closely related series of rocks which have a common origin, i.e., they were at one time all volcanic ashes.

2. The “*Argiles fissilaires*” represent certain local horizons in the early Tertiary ash and bentonite series, especially associated with the Casamayor Formation, which have been thoroughly infiltrated and replaced by opal.

3. The silicification of the “*Argiles fissilaires*” rocks by opal has been more or less confined to rather local areas in certain horizons in the original volcanic ash. This is thought to be due at least in part to the porous nature of the volcanic ash. Porous unaltered ash beds would be easily permeated by circulating solutions, whereas beds which were partially or entirely altered to bentonite would not be so easily permeated, for the clay-like nature of the bentonites would tend to obstruct the circulation of solutions.

4. The “*Argiles fissilaires*” is not considered to be a distinct formation lithologically but is rather a local member of the Tertiary sequence, or of the Casamayor, made prominent in the field because of the frequently bright color, and the presence of opal, which gives a rock highly resistant to the forces of erosion.

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THE "BUCKWHEAT PROBLEM" AND THE BEHAVIOR OF
THE HONEY-BEE

BY FRANK E. LUTZ

It has been abundantly demonstrated that the ordinary honey-bee can be quickly trained to associate given odors, or colors, or even color-patterns, with the presence of food so that, when foraging, it will hunt out the associated odor, color, or pattern among alternatives. Beling, in a most interesting and able paper¹ of which I was unfortunately not aware when reporting on the diurnal rhythm of certain Orthoptera,² has shown that this same bee can be trained to associate the presence of food with a certain time or times of the day even when in constant illumination, temperature, and humidity. This is quite different from what is ordinarily thought of as an "internal rhythm." He says that they appreciate points of time but not periods of time, since he could not train them to seek food every nineteen hours, in which case the feeding time came at a different point in successive twenty-four-hour days.

In discussing the biological aspects of his experiments, Beling speaks of what I have ventured to call the "buckwheat problem" as follows (translated):

A sense of time so well developed has in all probability a biological significance. The observation of v. Buttel-Reepen (1915, 'Leben und Wesen der Bienen,' Braunschweig) gives the first clew: "For example, buckwheat produces nectar only in the forenoon up to about 10 o'clock. After that time one sees on the blossoming and fragrant fields scarcely any bees. On the morrow, however, at an early hour hundreds of thousands are again in evidence and disappear in turn toward 10-11 o'clock in spite of the fact that the fragrance and the wide blossoming meadow exercises the same attraction."

In this instance the biological significance of the time-sense ought to be sought. In view of the well-known activity of the bees in relation to flowers it is to be assumed that the buckwheat bees spend the remainder of the day in the hive. At artificial feeding places it may in fact be easily observed that during the feeding intermissions they remain quietly upon the combs. Here they are secure. Through frequent inspections of their dried-up springs they would merely expose themselves needlessly to the many dangers of their flight service and to no purpose would use up their energy.

¹1929, 'Über das Zeitgedächtnis der Bienen,' Zeit. f. Vergl. Physiol., IX, pp. 258-338.

²1932, American Museum Novitates, No. 560.

Conceding that buckwheat has nectar only from 9-11 o'clock, it may well be that other plants as well produce nectar only at particular and limited hours of the day. The bees which visit in flight one and the same species as long as this species is productive are in this way "trained" to the daily periodic nectar production (perhaps also pollen production). In this way provision would be made for the punctual daily visit of all bee flowers; the time memory of the bees would accordingly be an adaptation to conditions of floral biology and concomitantly a weighty factor in the pollination of species of flowers through insects.

Beling then cites many instances of flowers which are open during only a limited and definite part of the day. Those used by Linnacus in his "floral clock" are classic examples. If, however, the bees make use of their time-sense to guide them to one species of flower at one time of the day and to another at another hour, they must be able to do more than tell time and discriminate between colors and odors. They must be able to associate the combination of several colors or odors, times, and food.

The present experiments were designed to consider this problem alone. The subject itself and the apparatus used raised interesting questions concerning the psychology of individual bees but, possibly unwisely, attention is confined here to the behavior of the population as a whole.

Since it is said that the buckwheat does not change either color or (a bit doubtful) odor when it starts and stops secreting nectar, a simple experiment involves two kinds of "artificial flowers" differing only in color and times of offering food to the bees. We can have one of these kinds offering sugar-water between 9 and 11 A.M. and the other doing so between 2 and 4 P.M. However, to meet the requirements of the problem, the artificial flowers should be present and open at all times and, to prevent a change of odor, the odor, if any, of sugar-water should always be in each of them.

Two units were arranged. Each unit consisted of three boxes, each box being about 12 cms. on a side. The three boxes of each unit were placed in a row. The central box contained an inverted jar of sugar-water placed on strips of blotting paper in a shallow dish, constantly providing a supply of food without danger to the bees. This central food-chamber communicated by one-centimeter holes with the box on each side; but either or both holes could be shut off by wire screen. When a hole was screened the odor, if any, of the sugar-water could escape into the side-box but bees could not get from that box to the food.

Each side-box was provided with an entrance-hole about a centimeter in diameter in its front. Around each hole was a colored cardboard

about 6 cms. square with the hole at its center. Two colors were used: white strongly reflecting ultraviolet and white weakly reflecting ultraviolet. Any side-box might bear either color, but usually one side-box of a given unit bore one of the contrasted colors while the other side-box bore the other color. The combination of two units included two "flowers" of each color. The colored cards were not only changed frequently from box to box but fresh cards were put out every few days and in all tests so that bee-odors could not give a clew as to the right box.

In the early part of the work (up to July 26) bees entered and left a side-box by the same hole, the one in the center of the colored card. This is as it would be in a flower. However, it resulted in a bad traffic-jam at the hole of a right box during feeding time. Furthermore, incoming bees could readily determine from outgoing bees what the prospects were in a given box. Accordingly, starting July 27, a one-way traffic system was put into operation. After a bee had entered a side-box through the hole in the colored cardboard on the front of the box it went to the passageway from that box to the feeding chamber. If that passageway was not screened it obtained food and returned to the side-box. Whether it got food or not it could leave only by way of a rear exit.

Several devices were used to enforce this one-way traffic. A simple and quite satisfactory one was a trap-door made of light celluloid and hung so that it opened in only one direction, falling into place when a bee had passed. Bees trying to go the wrong way quickly learned to wait until a bee going in the right direction had opened a door. Then the waiting bee would slip in before the door completely closed. This was most frequent at the rear exits and was finally prevented by making the passageway barely the width of one bee.

This one-way traffic system involves several interesting points. There were no colored cards at the rear exits. A bee having obtained food in the central chamber and left by a rear uncolored door tended to come back to this door on its next visit, presumably because she made orienting observations as soon as she got into the open. Such observations would fix the location of the rear exit hole as the place where food might be obtained.¹ The bees, then, were required to learn not only that a given color meant food at a certain time but also that the surroundings in which they found themselves after getting food were not those to which they must come to get it.

¹An apparatus similar to this might be useful in determining the relative value to the bee of such orientation observations (also as to the relative value of preceding and succeeding stimuli; and so on), but these problems were not attacked in the present work.

TABLE 1.—A summary of data

Mid-time	June 29 July 1		July 4, 6, 8		July 10, 12		Test July 14		July 18, 20, 24		July 30 Aug. 1		Test Aug. 2		Test Aug. 4		Test Sept. 12	
	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U	Aver. No. per Min.	Per cent U
7:50	17.5	44	10.6	15	5.7	47	0	..	9.0	52	7.0	21	6.0	63	...	..	7.2	67
8:10	16.0	42	8.5	41	8.3	45	6.0	42	9.0	67	6.3	36	8.4	55	10.0	70	12.8	89
8:30	9.7	31	10.8	42	14.3	47	17.0	44	10.7	66	8.3	61	10.0	50	17.0	88	12.4	95
8:50	10.0	32	11.8	34	19.3	55	31.0	31	7.6	61	9.0	43	11.2	50	14.0	79	21.6	96
9:10	61.7	62	62.7	60	52.3	66	27.5	56	62.8	71	28.3	58	19.6	52	31.0	93	24.8	97
9:30	93.3	76	105.3	71	94.5	78	20.5	46	99.2	75	33.5	71	30.4	47	30.0	93	29.6	89
9:50	95.3	71	88.5	78	101.5	79	19.5	41	101.0	81	55.3	66	23.2	47	47.0	98	36.4	78
10:10	109.5	75	101.2	81	114.8	79	17.5	43	87.7	79	56.3	81	16.0	42	42.0	95	27.2	69
10:30	103.5	82	94.5	81	108.5	83	10.0	25	87.7	87	68.0	87	16.8	43	31.0	93	5.6	74
10:50	95.7	87	102.3	81	101.3	87	8.0	31	84.5	82	73.0	80	12.8	47	36.0	97	3.6	71
11:10	....	..	....	..	....	..	7.0	21	....	..	116.7	71	9.2	47	46.0	91	0.4	50
11:30	34.3	75	37.0	71	64.8	67	3.5	43	15.3	74	24.7	65	6.8	39	42.0	93	0.8	100
11:50	21.0	62	21.0	53	34.5	63	4.0	38	14.0	75	7.7	52	2.0	40	49.0	92	1.2	60
12:10	17.5	71	21.3	43	10.0	80	15.0	33	14.3	63	7.0	85	2.0	40	37.0	95	...	..

Mid-time	June 29 July 1		July 4, 6, 8		July 10, 12		Test July 14		July 18, 20, 24		July 30 Aug. 1		Test Aug. 3		Test Aug. 4 ¹		Test Sept. 12	
	Aver. No. per Min.	Per cent N	Aver. No. per Min.	Per cent N	Aver. No. per Min.	Per cent N	Aver. No. per. Min.	Per cent N	Aver. No. per Min.	Per cent N	Aver. No. per Min.	Per cent N	Aver. No. per Min.	Per cent N	Aver. No. per Min.	Per cent U ²	See text	
12:50	19.0	44	14.3	49	5.8	40	23.0	72	13.5	19	8.5	59	2.8	44	48.0	2		
1:10	22.0	36	24.2	50	5.1	41	21.5	58	10.0	60	9.0	44	10.4	44	46.0	4		
1:30	16.3	52	20.0	53	6.6	50	24.5	61	....	..	16.3	40	9.6	42	43.0	7		
1:50	14.0	54	23.5	54	7.1	46	25.5	70	11.7	43	15.0	48	5.6	33	47.0	4		
2:10	35.5	57	46.7	80	19.7	69	19.0	66	41.5	78	22.0	70	2.8	64	53.0	4	1.2	50
2:30	82.3	80	75.3	80	25.3	76	20.5	61	95.8	70	44.0	85	7.2	48	53.0	0	2.4	67
2:50	89.3	78	76.4	87	28.3	81	13.5	65	111.8	80	64.5	89	19.2	56	45.0	2	9.2	54
3:10	101.7	85	94.2	83	26.8	89	15.5	52	85.0	79	62.3	72	16.4	51	41.0	10	23.6	63
3:30	91.5	85	80.2	89	26.8	88	14.0	57	88.7	84	67.3	80	13.6	53	46.0	7	45.6	60
3:50	78.5	82	79.0	90	27.3	91	4.0	88	100.0	90	66.0	83	9.6	60	34.0	6	57.6	84
4:10	....	..	....	..	....	..	4.5	67	....	..	84.7	62	8.4	57	37.0	19		
4:30	49.5	71	36.4	74	11.3	77	3.0	67	40.7	74	17.0	53	1.2	50	32.0	34		
4:50	22.5	60	13.0	74	4.5	83	1.5	67	16.5	76	4.0	50	0.4	100	38.0	26		
5:10	5.0	60	6.0	44	....	..	See text		....	..	....	..	....	...		See text		

¹Bees swarmed the next day, possibly accounting for the small numbers.

²Note that in this case U, not N, is the "right" color, although N was also open in this test, but that feeding at either color in the afternoon is "wrong."

Starting with the type of apparatus in which the bees both entered and left by way of holes in colored cards, the two units, giving a total of two white-ultraviolet cards and two white-not-ultraviolet cards, were placed on a bench about fifteen meters from a hive but around a corner so that the apparatus was not visible from the hive. Owing to the shortness of the flight between the hive and the apparatus, frequent trips, hence frequent training, was possible. Individually marked bees were found to be making ten or twelve round-trips per hour during feeding times. During these times there were frequently, as may be seen in Table I, more than a hundred bees per minute entering the apparatus, or about 6000 per hour. If each bee made ten trips per hour, the experiment involved something like five or six hundred individual bees at a time. Of course, as the experiment progressed some bees died or were attracted elsewhere and, also, new ones joined the throng at the apparatus.

By means of marking bees which came to the apparatus in the afternoon and noting that they were also there in equal numbers in the morning, it was evident that we were not dealing with two populations, a morning one and afternoon one.

Table I shows the average number of bees per minute actually entering the apparatus. The countings on which these averages are based were timed by a device that gave an audible signal at one-minute intervals. When the bees were entering in large numbers it was possible to count those at only one hole at a time. Some time was consumed in recording the scores and, consequently, there were usually not more than two one-minute counts for each box in any one ten-minute interval. Particularly before the one-way system was installed, it was difficult for more than forty bees per minute to enter through one hole. This results in the table understating the maxima. For example, for 10:30 A.M., June 29 and July 1, the Table shows that on the average 82 per cent of 103 bees entered the two white-ultraviolet boxes. This is 42 bees per minute per box. When that rate was reached or even approached many bees were crowded around the holes in the white-ultraviolet cards trying to get in. On the other hand, the table somewhat overstates the number of bees at the apparatus when the food was screened off. This is due to the fact that a bee, not being able to get food at one box, would enter one or two others and might even re-enter them before leaving, whereas if it had found food it would have remained to feed. Thus, when the table states that an average of five bees per minute entered the apparatus there may actually have been an average of only, say, three individuals involved.

In the first part of the experiment food was to be had during the morning hours from nine to eleven by going to the white-ultraviolet boxes and during the afternoon hours from two to four by going to the white-not-ultraviolet boxes. The first three and the fifth double columns of Table I show the behavior of the bees during the first eight weeks of such training. A few bees were exploring the apparatus at all times but within a few minutes after the screens were removed at 9:00 A.M. from the holes leading from the white-ultraviolet boxes to food many more bees came and most of them entered the white-ultraviolet boxes. Shortly after these holes were screened at eleven the number of visiting bees dropped off but increased again when the holes leading from the white-not-ultraviolet boxes to food were unscreened at 2:00 P.M. From 2:00 P.M. to 4:00 P.M., while these latter holes were open, most of many visiting bees entered the white-not-ultraviolet boxes. When these gates were closed with wire screen at 4:00 P.M. the number of visiting bees again dropped off to a small number which kept coming as long as daylight lasted. No records are given for the 11:10 and the 4:10 periods because immediately after the passageways to the feeding chamber were screened the entrance-holes in the side-boxes became clogged with bees, some trying to get out because they had found access to food cut off and others trying to get in.

It is to be noted (1) that bees were very abundant during feeding times and not very abundant at other times; (2) that at feeding times most of them went to the right boxes (U in the morning and N in the afternoon); but (3) before the screens were removed there was not a very marked preponderance of bees going to what would shortly be the right color.

The fourth double column of Table I gives the result of a test made July 14, after about two weeks of training. During this test the screens were not removed but everything else was kept as it was during training. There appeared to be a slightly increased number of visiting bees just before and in the early part of normal feeding times but, as to choice of colors, there was a slight preponderance of bees going to the white-not-ultraviolet color in the morning as well as in the afternoon. This was the color at which the bees had last found food (during the afternoon of the day before). At 5:10 P.M. on the day of this test the screens between white-not-ultraviolet boxes and food were removed. During the succeeding ten minutes bees came at the rate of about one per minute. Those that entered the white-not-ultraviolet boxes fed and returned to the hive. Almost immediately a horde of bees came to the apparatus.

Thus, in the next ten minutes (5:20 to 5:30) they came at the rate of 80 per minute, of which about 91 per cent went to the two white-not-ultraviolet boxes. This kept up as long as good daylight lasted—long after normal feeding time.

As previously stated, the one-way system was installed July 26. The sixth double column of Table I gives a sample (July 30, August 1) of the behavior of the bees under this system. The smaller number of bees in the record is to be accounted for by the fact that many, perhaps most, of the visitors spent considerable time trying to get in by way of the rear exits. Otherwise there seemed no marked difference. To be sure, the July 18, 20, 24 bees were about 80 per cent "right" during feeding times and the July 30, August 1 bees were only about 77 per cent right during these times but, even if this difference were significant, it might be accounted for by the fact that after the one-way system was put into effect incoming bees could get no information from outgoing ones as to which was the right box.

The next test was divided between the morning of August 2 and the afternoon of August 3. In the afternoon of August 2 the white-not-ultraviolet boxes and in the morning of August 3 the white-ultraviolet boxes gave access to food as usual, but during the morning of August 2 and the afternoon of August 3 the screens were not removed. These tests confirmed that of July 14. The bees had learned a certain amount of periodicity but they had not developed a fixed habit of going to white-ultraviolet during the morning and white-not-ultraviolet during the afternoon.

In the test of August 4 the screens between the white-ultraviolet boxes and food were removed at the start and not replaced during the rest of the day. The screens between the white-not-ultraviolet boxes and food were not removed. It will be noted in the August 4 columns of Table I that the bees came in considerable numbers throughout the day and visited almost exclusively the white-ultraviolet boxes. In fact, as late as 7:00 P.M. they were still coming at the rate of eight per minute, of which 90 per cent went to the white-ultraviolet boxes.

The results to this date seem to point very clearly to the following conclusions so far as this experiment is concerned. The behavior of the bees when food is available at one color during certain morning hours and at another color during certain afternoon hours is distinctly practical. They come in large numbers to the right color at the right time but there are always a few individuals "prospecting" at other colors and during other times. However, when conditions change, as when on July 14 food

was suddenly offered long after "normal" time or on August 4 when one color offered food during the whole day, the bees almost immediately took advantage of the new situation. Likewise, it was found that the coming of bees in large numbers during a normal feeding time would stop within a few minutes if the screens were replaced, preventing them from getting food. In other words, the bees as a whole did not spend much time in unrewarded endeavor.

It is not clear whether the population was or was not trained to come at definite times of the day. The behavior when food was offered at these times may be and probably is largely explained by the known fact that "prospecting" bees returning to the hive with food stir the swarm into activity. The July 14 and August 2-3 tests, when food was present but not available, show slight increases in the number of visiting bees at or near normal feeding times. These increases certainly are not great. Nevertheless, the tendency may have been there but kept from being more evident by the failure of prospecting bees to return to the hive with food.

It seems quite evident that the population acquired no very definite association between color and time of feeding. Even if this be true, it is not proof that the bees could not acquire such an association. From a practical point of view such an association was not necessary; the bees could quickly determine which color, if either, offered food and govern themselves accordingly.

If these things be true, it would seem that the solution of the "buckwheat problem" is rather simple and does not necessarily involve any training to either feeding time or color. During daylight hours there are always "prospecting" bees hunting here and there in the buckwheat fields as well as elsewhere. If they find buckwheat offering nectar they feed and return to the hive. Their return starts an activity in the swarm¹ and soon the buckwheat field is full of bees. When the buckwheat stops offering nectar most of the bees stops visiting it and turn their attention elsewhere.

On August 5 the hive used in the experiment just discussed sent off a large swarm. In fact, the relatively small number of bees in the August 4 test, when food was offered all day, may have been due to preparations for this swarming. Furthermore, circumstances arose which prevented me from continuing detailed observations on bees. It was possible, however, to add the following as a sort of an appendix to the foregoing.

¹See von Frisch.

Since the colors used, "white-ultraviolet" and "white-not-ultraviolet," appeared to human eyes to be practically alike,¹ it is natural that students who are not yet thoroughly convinced that bees in nature differentiate between these colors should question the validity of conclusions based on their use. Personally, I think that the foregoing experiments answer that question quite clearly. During the feeding times the positions of the cards and, of course, the corresponding positions of the wire screens were changed every fifteen or twenty minutes on the average. Nevertheless, once the bees found which color was offering food, they were rather faithful to that color until it failed them. Without doubt they were somewhat confused by the fact that sometimes it was one color and sometimes it was the other; but there was evidence that they remembered overnight which color was last the "right" one. It is quite possible, but far from certain, that the bees can not, as well as did not, acquire and act upon the complicated associations offered.

Starting August 7, the bees were fed at white-ultraviolet between 9:00 and 11:00 A.M. as before, but the screens were not removed at other times. Although the white-not-ultraviolet cards were out as before, the corresponding screens were not removed.

On the morning of September 12 (see Table I) all food was removed from the food-chambers and all of the openings to them were left unscreened. There was an evident peak in the number of visiting bees during what had been feeding time and at first there was a marked faithfulness to the feeding-color, white-ultraviolet. This faithfulness decreased, one is tempted to say, when it was found to be unrewarded. Starting at 2:15 P.M., food was put in the feeding chambers and all of the openings were still left unscreened. It will be seen (1) that, although it was not normal feeding time and only a few "prospecting bees" were about, the sudden supply of food quickly brought others in large numbers and (2) that, although food was just as available at white-not-ultraviolet as at the white-ultraviolet (to which food had for the preceding month been confined during two morning hours), the bees tended to secure the food by way of the accustomed white-ultraviolet.

This supplementary experiment, incomplete as it is, is in line with the preceding one and strengthens the belief that, even though the bees may be able to acquire the complicated associations involved in Beling's solution of the "buckwheat problem," they do not need and probably do not use this ability. They take their food where, and when, they find it, apparently being guided largely by the circumstances of the moment.

¹See Lutz, 1933, *American Museum Novitates*, No. 641.

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FOSSIL TURTLES OF MONGOLIA: SECOND CONTRIBUTION¹

BY CHARLES W. GILMORE²

INTRODUCTION

The present paper embodies the results of my study of fossil turtles collected in Mongolia by the 1930 Asiatic expedition of The American Museum of Natural History and completes my investigations on the entire Mongolian Chelonian collection, as those secured prior to 1930 were discussed in a previous communication.³

Of outstanding importance in the present collection is an assemblage of fourteen trionychids, half of which were found so closely intermingled as to be taken up intact in one large block of matrix (see Fig. 7). Several of these had not only the carapace and plastron preserved but the skull, vertebrae, limbs and feet. Study has disclosed that all pertain to a single species, and, as both juvenile and adult individuals are present, the assemblage probably constitutes the most comprehensive representation of a single extinct species of a trionychid turtle ever discovered.

The presence of a single neural between the first pair of costals and the absence of marginal bones indicate the affinities of these specimens to lie in the genus *Amyda*. Since they represent an undescribed species, the name *gregaria* is proposed, in reference to their gregarious habits.

Family TRIONYCHIDÆ

Amyda gregaria, new species

TYPE:—A.M. No. 6734, consists of carapace, plastron and much of skeleton lacking the skull. Collected in 1930 by the Central Asiatic Expedition.

PARATYPES:—A. M. No. 6735, consists of skull, lower jaws and portions of carapace, plastron and skeleton. A. M. No. 6736 is a nearly complete skeleton of a juvenile individual. Both collected in 1930 by the Central Asiatic Expedition.

LOCALITY:—Camp Margetts, 25 miles southwest of Iren Dabasu, Inner Mongolia.

HORIZON:—Houldjin, Middle Oligocene.

DIAGNOSIS:—Carapace much longer than wide, truncated posteriorly in the adult; seven or eight neurals, eighth much reduced. Length of nuchal more than half the width of carapace and in the adult not overlapping the rib ends of the first pair of

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 119.

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³Gilmore, Charles W. 1931. 'Fossil Turtles of Mongolia.' Bull. Amer. Mus. Nat. Hist., LIX, Art. IV, pp. 213-257.

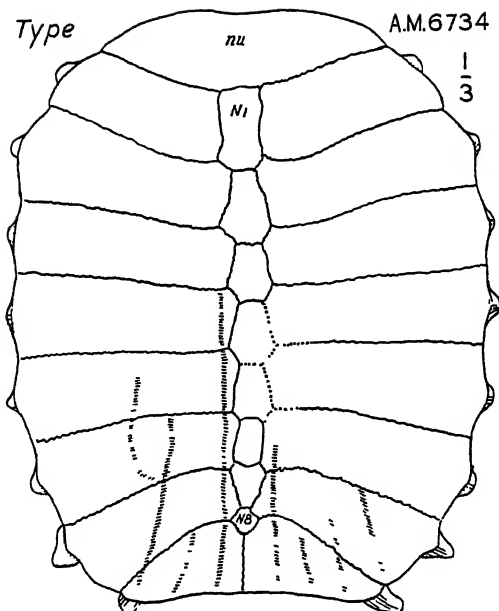


Fig. 1. Carapace of *Amyda gregaria*, new species. Type. A. M. No. 6734. One-third natural size.

N_1 , N_8 , neurals one and eight respectively; nu , nuchal.

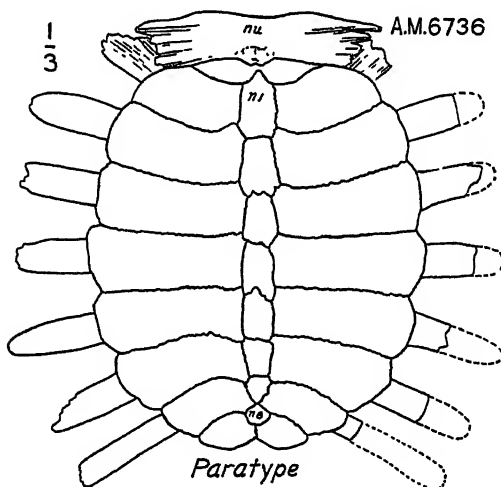


Fig. 2. Carapace of *Amyda gregaria*, new species. Paratype. Juvenile. One-third natural size. A. M. No. 6736.

N_1 , N_8 , neurals one and eight respectively; nu , nuchal.

costals; opposite sides of carapace parallel. Snout on the skull shorter than the diameter of the orbit; length of supratemporal fossa less than the longitudinal diameter of orbit. Orbit nearer the temporal than the nasal fossa.

The specimen selected as the type of *Amyda gregaria* is probably adult although not an aged individual, as indicated by the open sutures of all parts of the carapace. It was found not far removed from the group shown in figure 7.

The carapace is sub-elliptical in form, broadly rounded in front and decidedly truncate behind. In the juvenile specimens the posterior end is rounded with a slight median notch as shown in figure 2. Antero-posteriorly the carapace appears to have been but slightly arched, but transversely it is strongly convex, especially on the outer third of the costals. In a straight line the length is 230 mm.; the greatest width is 195 mm. The other adults shown in figure 7 vary in length from 232 mm. to 266 mm., measured as they lay in the matrix.

In the type there are eight neurals, and both juveniles carry a similar number. In A.M. Nos. 6728, 6729 and 6731 (see Fig. 7), however, there are only seven, but this is a variation often observed in other species of the Trionychidae. The shell of this species is moderately thin.

The neural series of the several individuals are remarkably similar in shape and general proportions. The first neural is wider behind than in front; the next four are coffin-shaped; the sixth usually quadrangular; the seventh triangular; and the reduced eighth, when present, is sub-circular in outline and usually in contact with the seventh. Their dimensions are given in the accompanying table:

COMPARATIVE MEASUREMENTS OF NEURALS

Neurals	Length		Width	
	Type A. M. No. 6734	Paratype A. M. No. 6736	Type A. M. No. 6734	Paratype A. M. No. 6736
	mm.	mm.	mm.	mm.
1	32	25	19	13.5
2	25	22	19	16
3	22.5	20	17	15
4	....	19	....	13
5	....	18	....	10.5
6	18.5	15	10	10
7	16	10	12	9
8	10	7.5	9.5	8.5

The nuchal of the type has an antero-posterior extent of 30 mm. and measures about 115 mm. from side to side. The anterior border is shallowly concave on the median line. In none of the adult specimens do the ends overlap the first costal ribs, although they do so in the juvenile specimen shown in figure 2.

The form and relative proportions of the costal bones are plainly shown in figures 1 and 2. Excepting the eighth pair, the costals are remarkably uniform in all available specimens. In specimens A. M. Nos. 6729 and 6731 the eighth pair of costals are much reduced trans-

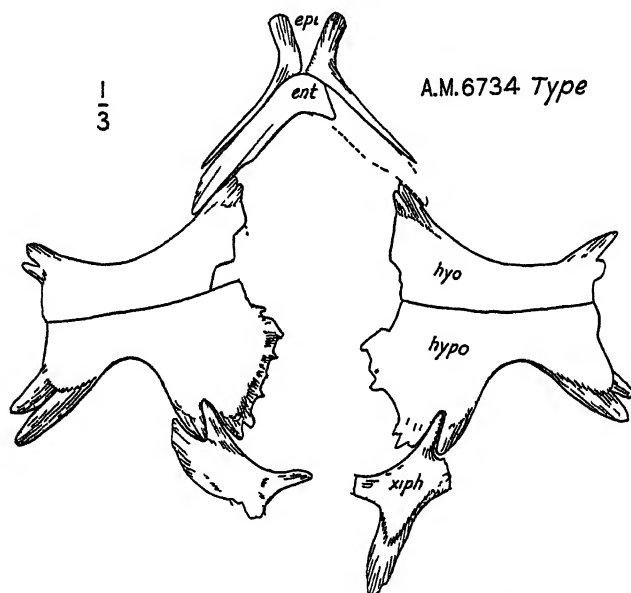


Fig. 3. Plastron of *Amyda gregaria*, new species. Type. A. M. No. 6734. One-third natural size.

Ent., entoplastron, *epi*, epiplastron, *hypo*, hyoplastron, *hypo*, hypoplastron; *xiph*, xiphoplastron.

versely, in this respect being intermediate between the type and the juvenile specimens. The free borders of the costals are steeply beveled off to an acute lower edge. In the type some of the posterior ribs project 38 mm. beyond the edge of the carapace. The entire upper surface of the carapace is beautifully sculptured (see Fig. 8). The sculpture consists of a series of shallow pits, irregular in both size and shape and surrounded by curved ridges narrower than the pits, the whole forming a honeycomb arrangement. There are usually a series of 5 and 6 pits in a line 10 mm. long. The sculpturing is less distinct on the neurals and proximal ends

of the costals. On the outer halves of most of the costals there is a tendency for the pits to arrange themselves in rows parallel with the axis of the shell. The outer beveled edge of the costals is free from ornamentation. In addition to the pits and ridges, the shell of the adult is ornamented by a series of longitudinal welts. These are most conspicuous on the posterior part of the shell as indicated in figure 1. In the type the seventh and eighth costals are crossed by no less than seven of these welts. The one paralleling the neurals on the left side extends forward as far as the third costal. The welts resemble those found in the shells of certain species of *Plastomenus* and *Trionyx*. They are absent in the juvenile specimens.

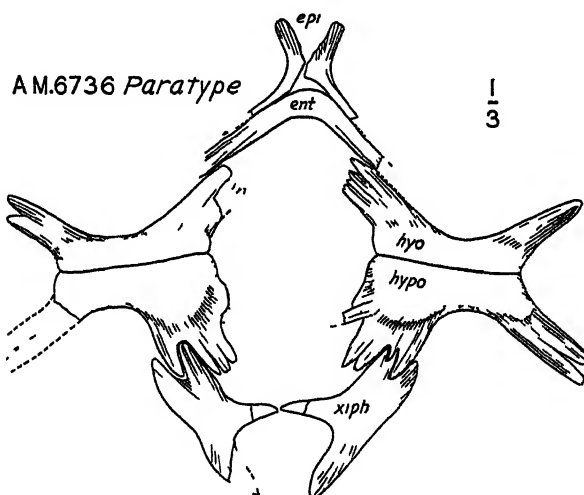


Fig 4 Plastron of *Amyda gregaria*, new species. Paratype Juvenile. A. M. No 6736. One-third natural size

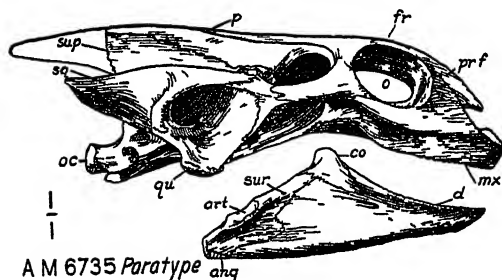
Ent, entoplastron, *epi*, epiplastron *hypo*, hyoplastron, *hypo*, hyoplastron *xiph*, xiphiplastron.

All of the plastron elements are present in the type. The plastron (see Fig. 3) encloses large median fontanels. The bridge, where narrowest, is 35 mm. wide, of which 21 mm. belong to the hypoplastron. The limbs of the entoplastron are 81 mm. long and unite to form less than a right angle. The hypoplastral suture is 82 mm. long. The xiphiplastron is 80 mm. long and about 34 mm. broad.

In the young, the plastron is remarkable for the narrowness of the bridge and the depth of the notch between the outer process of the hyoplastron and that of the hypoplastron, as well as the relatively greater

length of the finger-like processes of these bones. It is quite evident that, with advancing age, the bone grows out to fill much of this notch, thus reducing the length of the processes. This change is clearly indicated in figures 3 and 4. The xiphiplastron in this species differs from any described species of *Amyda* in that its two elements meet on the median line by a single slender, sharply pointed process, instead of the usual two interdigitating processes. The form of the various plastral elements of both juvenile and adult individuals is clearly shown in figures 3 and 4. The sculpture of the plastral bones is finer and more regular in its pattern than on the carapace.

Specimen A. M. No. 6735 consists of the skull and lower jaws, incomplete skeleton and shell, but the skull is fairly complete and serves as a fine example for depicting the features of the cranium since most of the sutures can be clearly traced, as shown in figures 5 and 6.



A M 6735 Paratype ahq

Fig 5 Skull of *Amyda gregaria*, new species. Paratype. A. M. No 6735. Lateral view. Natural size.

Ang, angular art, articular, co, coronoid d, dentary, fr, frontal, mx, maxillary, o, orbit; oc, occipital condyle, p, parietal, prf, prefrontal, qu, quadrate, sq, squamosal, sup, supraoccipital; sur, surangular.

The length of the skull from the tip of the snout to the occipital condyle is 55 mm.; the greatest width at the upper posterior border of the tympanic cavity is 34.5 mm. From the fronts of these cavities the skull gradually narrows to the bluntly rounded snout. Viewed laterally the face drops rapidly in front of the orbits as in *Amyda mira* Hay.

The tympanic chambers are large, the antero-posterior dimensions being 11 mm., dorso-ventrally 8.5 mm. The orbits are large and sub-round, having a greatest diameter of 10.5 mm. The interorbital space is 5 mm. wide. The snout projects 13 mm. beyond the orbits. Length of supratemporal fossae less than the longitudinal diameter of orbit. Orbit nearer the temporal than the nasal fossa.

The pterygoid portion of the palate has a width of 20 mm. The middle of the choanae is about the middle of the orbit. The triturating surfaces of the upper jaws opposite the posterior border of the choanae are 6 mm. wide but gradually narrow anteriorly.

Most of the sutures of the skull can be clearly traced as shown in figures 5 and 6, but they show no characteristics that would serve to distinguish the skull from other described species.

Comparison of the vertebrae, girdle, limb and foot bones with the homologous parts of other trionychids, both living and extinct, failed to

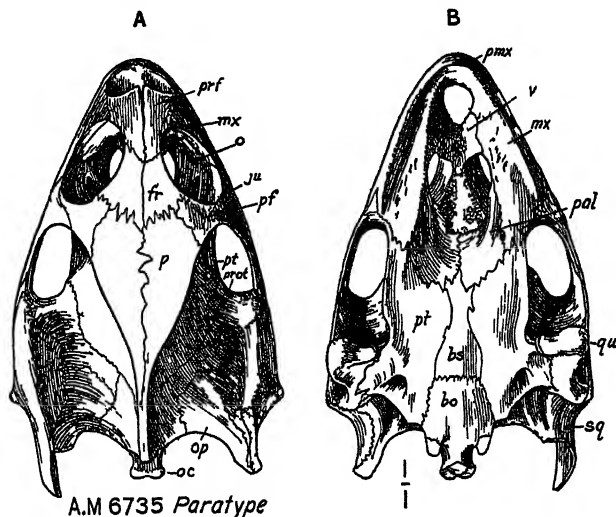


Fig. 6. Skull of *Amyda gregaria*, new species. Paratype. A. M. No. 6735. Natural size.

A, superior view, B, inferior view. Bo, basioccipital, bs, basisphenoid; fr, frontal; ju, jugal; mx, maxillary, o, orbit oc, occipital condyle, op, opisthotic, p, parietal, pal, palatine; pf, postfrontal pmx premaxillary, prf, prefrontal, prot, prootic, pt, pterygoid, v, vomer, qu, quadrate; sq, squamosal

disclose characters that would serve to further distinguish the present species.

In form and arrangement of the carapace elements, the present species has its nearest resemblance to *Amyda egregia* Hay¹ from the Eocene (Bridger) of Wyoming. The smaller size of *Amyda gregaria*, relatively shorter nuchal, finer character of ornamentation and greater lateral development of the eighth pair of costals, would at once distinguish it.

¹Hay, O P 1908 'Fossil Turtles of North America,' Carnegie Institution of Washington, p 531.

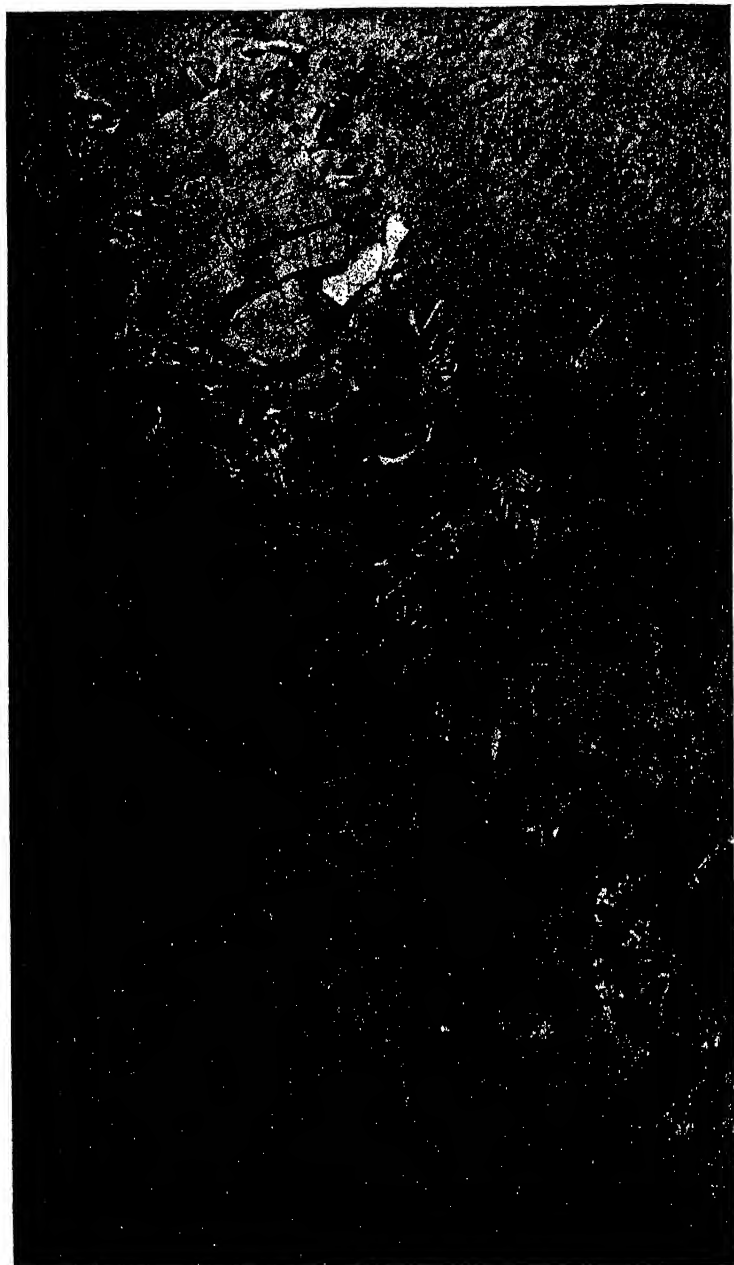


Fig. 7. Slab showing several specimens of *Amyda gregaria*, new species, as they were found in the field and as now exhibited in the American Museum of Natural History. A. M. Nos. 6728, 6729, 6730, 6731, 6732 and 6733 (young). About one-sixth natural size.

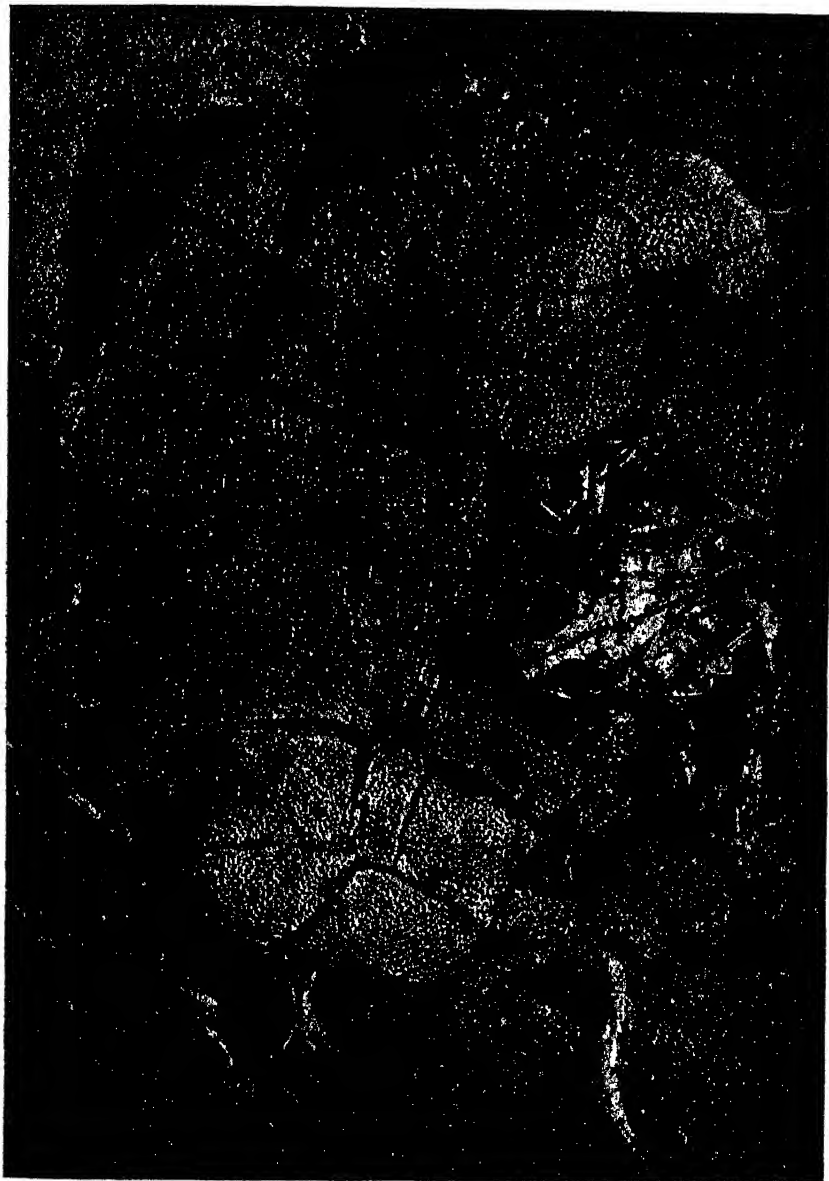


Fig. 8. Specimen of *Amyda gregaria*, new species. A. M. No. 6729. To illustrate the character of the ornamentation, as all of the specimens are in close agreement. About one-half natural size.

NOTES ON JUVENILE SPECIMENS

A few of the modifications that take place in the form and structure of the trionychid carapace and plastron during the growth of the individual are beautifully illustrated by the present series of specimens. So striking are some of these changes between young and adult individuals, that had the present specimens been found wide apart there would have been little possibility of their recognition as pertaining to the same species.

That the two juveniles, A. M. Nos. 6733 and 6736, are the young of the larger specimens of the present aggregation is quite certainly indicated not only by their smaller size, but by their association in the field, by the similarity of the sculpturing, and especially by the close correspondence in all particulars of the skulls and various skeletal parts.

The immaturity of the two specimens (A. M. Nos. 6733 and 6736) is shown by the open sutures, the strongly protruding rib ends, and the loose attachment of the nuchal bone. This element in the juvenile specimens shows no indication of bony attachment with the carapace, whereas in the larger and older individuals it is suturally joined along the entire posterior border. Furthermore, when the nuchal of the young is placed in position (see Fig. 2), it overlaps the rib ends of the first costals, while in the adult the outward expansion of the first costals leaves the nuchal entirely inside the rib ends (see Fig. 1). At the same time there is a decided modification in the form of the nuchal ends from a wide digitate termination to a triangular pointed extremity as shown in figures 1 and 2. The superior surface of the adult nuchal is completely sculptured, whereas in the juvenile only a small angularly rounded patch near the center of the bone is ornamented, the remaining surface being smooth.

With advancing age the rear of the carapace also undergoes striking changes. The rounded end with median notch of the juvenile becomes in the adult widely truncate, while the greatly reduced seventh and eighth pairs of costals increase decidedly in size.

Further substantiation of the identity of these young and adult forms is furnished by a series of specimens of *Trionyx muticus* from the Mississippi Valley in the United States National Museum, which display almost precisely similar modifications of the carapace between young and adult examples.

The changes in the plastron have been mentioned elsewhere. Comparison of the skull, vertebrae, girdle and limb bones shows no differences between juvenile and adult except the smaller size and less well defined processes and articular ends in the young.

These modifications in structure of the carapace brought about by growth of the individual, show that great care is necessary in order not to fall into error in a study of the fossil Trionychidae. In fact, in the light of the information furnished by the present assemblage of turtles, I am of the opinion that some of our described species were based upon specimens not fully adult, and for that reason the characters used to distinguish them cannot be relied upon as being constant.

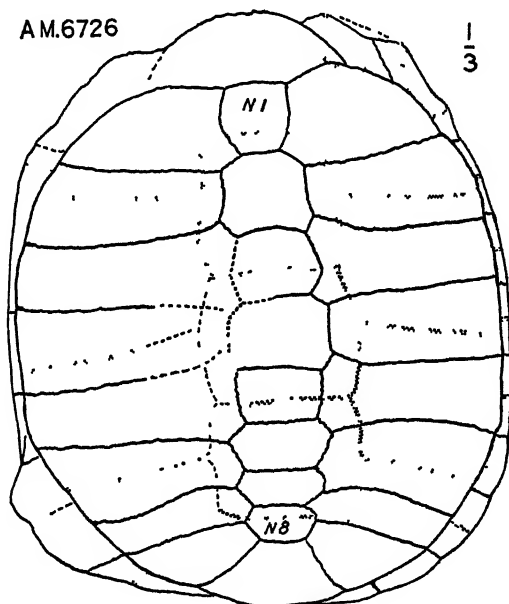


Fig. 9. Carapace of *Testudo shensiensis* Wiman. A. M. No. 6726. One-third natural size.
N1, N8, neurals one and eight respectively.

Family TESTUDINIDAE

Testudo cf. *shensiensis* Wiman

WIMAN, CARL. 1930. *Palaeontologia Sinica*, VI, pt. 3, pp. 28-33, Pl. v, figs. 1-16.

Three specimens, A. M. Nos. 6725, 6726 and 6727, collected from the Tung Gur formation at Wolf Camp, Gur Tung Khara Usu, Inner Mongolia, by the 1930 Central Asiatic Expedition, are provisionally identified as pertaining to *Testudo shensiensis* Wiman. No question can be raised as to this generic assignment, but imperfect preservation and our present lack of knowledge concerning the range of variation that may occur within a species of the Testudinata leave the specific allocation somewhat uncertain.

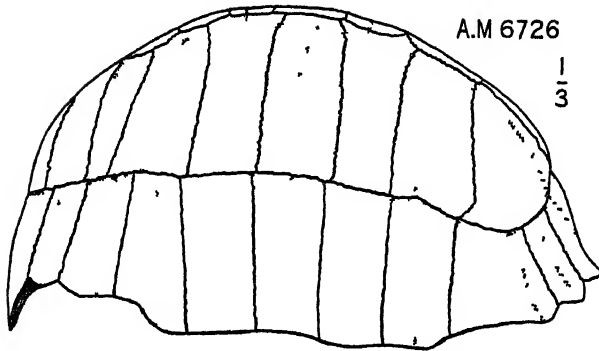


Fig. 10. Carapace of *Testudo shensiensis* Wiman. A. M. No 6726. Viewed from the right side One-third natural size.

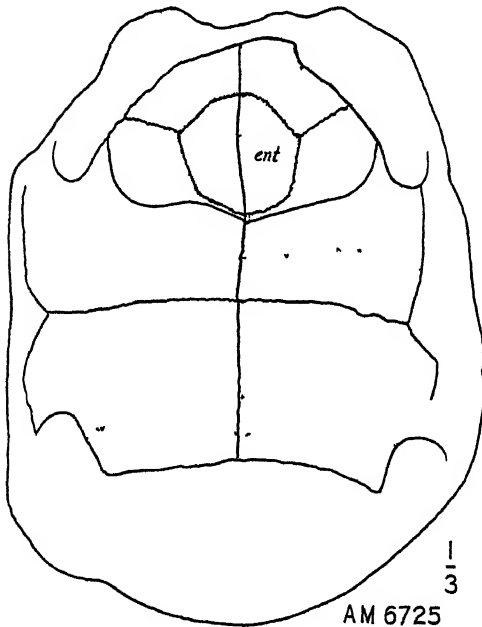


Fig. 11. Plastron of *Testudo shensiensis* Wiman. A. M. No. 6725. One-third natural size.

Ent, entoplastron.

Specimen A. M. No. 6727 has all of its detailed structure obliterated and is therefore valueless from a systematic standpoint. A. M. No. 6726 has the carapace fairly well preserved, but the plastron is almost entirely missing; A. M. No. 6725 has the carapace less well preserved, but the plastron lacking the posterior lobe is present. From this brief review of the available specimens, the difficulty of properly contrasting them is at once apparent. Quite certainly, however, all three are specifically the same.

In the general form of the high vaulted shell, having both the height and width greater than one-half the length, the greatest height at about mid-length; the rear steeply sloped with the pygal region extending downward below the level of the plastron; the costals alternately wide and narrow at their ends; the entoplastron pentagonal with the pectoral-humeral sulcus crossing behind it, are all features held in common with the type of *Testudo shensiensis* Wiman.

The specimens before me differ from that species in being slightly larger, and in the shape and arrangement of the neural bones; for example, in specimen A. M. No. 6726 the second and fourth neurals are octagonal, the third and sixth hexagonal, whereas in the type of *T. shensiensis* the second is octagonal, the third tetragonal, the fourth and sixth hexagonal. There are also slight differences in the shape and proportions of the vertebral scutes, as shown in the accompanying table.

COMPARATIVE MEASUREMENTS OF NEURALS

No.	Length		Width	
	A. M. No. 6727	Type of <i>Testudo</i> <i>shensiensis</i>	A. M. No. 6726	Type of <i>Testudo</i> <i>shensiensis</i>
	mm.	mm.	mm.	mm.
1	38	26	29	21
2	30	24	36	35
3	29	23	34	30
4	25	24	34	34
5	25	20	34	33
6	21	17	41	30
7	15	13	37	27
8	20	12	25	23

COMPARATIVE MEASUREMENTS OF VERTEBRALS

No.	Length			Width		
	A. M. No. 6726	A. M. No. 6725	Type of <i>Testudo</i> <i>shensiensis</i>	A. M. No. 6726	A. M. No. 6725	Type of <i>Testudo</i> <i>shensiensis</i>
	mm.	mm.	mm.	mm.	mm.	mm.
1	58	58	48	67	63.5	64
2	67	50	47	67	55	50
3	62		46		60	55
4			43		60	47
5			50		. .	73

In view of the fact that the neural series as illustrated by Wiman is not bilaterally symmetrical, and also that the observed differences are not greater than occur among individuals of *Styemys nebrascensis* Leidy that are regarded by American authorities as being variations well within the limits of a species, the reference of the specimens before me to *Testudo shensiensis* seems to be a logical assignment.

In this connection it is pertinent to call attention to the possibility that Doctor Wiman may have erred in establishing six species of *Testudo* all from practically the same geological horizon. A review of his paper convinces me that many of the characters used are not sufficient to properly distinguish them, and that with the acquisition of more specimens it will be found that the number of species will be reduced.

Trionychids Indet.

Two small carapace fragments collected by the 1930 Asiatic Expedition of The American Museum of Natural History, east of Irдин Manha, Mongolia, are the first record of a trionychid turtle in the Arshanto formation, Lower Eocene.

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AN UPPER MIOCENE SUID FROM THE GOBI DESERT¹

BY EDWIN H. COLBERT

Among the fossils collected by the Central Asiatic Expedition, are two palatal fragments of the genus *Listriodon*, which were found by the field party of 1930 in the Tung Gur beds, at a locality known as Wolf Camp in the Eastern Gobi, Inner Mongolia. As a corollary to some studies on *Listriodon* from the Siwalik beds of India, it has been thought well to bring out a special description of these Mongolian specimens, not only in view of the fact that they represent a new species of the genus, but also because they constitute a record of *Listriodon* from a portion of Asia where hitherto it had been unknown. The illustrations for this paper were made by Louise Germann.

Listriodon mongoliensis, new species

TYPE.—Amer. Mus. No. 26504. A palate with right and left P²-M³.

PARATYPE.—Amer. Mus. No. 26517. A right maxilla, with P²-M¹.

HORIZON AND LOCALITY.—From the Tung Gur (or *Platybelodon*) beds of Upper Miocene age. Both specimens were found in the Wolf Camp quarry, forty miles southeast of Iren Dabasu, Inner Mongolia.

DIAGNOSIS.—A very large *Listriodon*, comparable to *Listriodon splendens* in size. As in other members of this genus, the palate is very broad, and the enamel of the cheek teeth is rugose. *Listriodon mongoliensis* is characterized by the relatively narrow second premolar, and by the separate outer cusps of the fourth premolar. The molars are quite similar to those of *Listriodon splendens*.

Listriodon mongoliensis is very close to *Listriodon splendens* of the European Miocene, and to *Listriodon pentapotamiae* from the Lower Siwalik beds of India. Indeed, the correspondences between the molar teeth of these three species are so striking that we must needs look to the premolars in order to find differences that will help to distinguish the Mongolian form.

The second and third premolars of *Listriodon mongoliensis* are triangular in outline, each with one apex directed anteriorly. Thus the front portion of each tooth is very narrow, while the back portion is rather wide. Each tooth consists of a central cusp, from which an external ridge runs back to the posterior border. There is a low postero-internal cusp that is clearly an upgrowth of an expanded cingulum, and on the utmost postero-internal corner of the third premolar there is a

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 120.

cingular loop, which when moderately worn, would form a small fossette. A slight anterior cingulum is present in both teeth. The second premolar is distinguished from the same tooth in *Listriodon splendens* or *Listriodon pentapotamiae* by its relative narrowness.

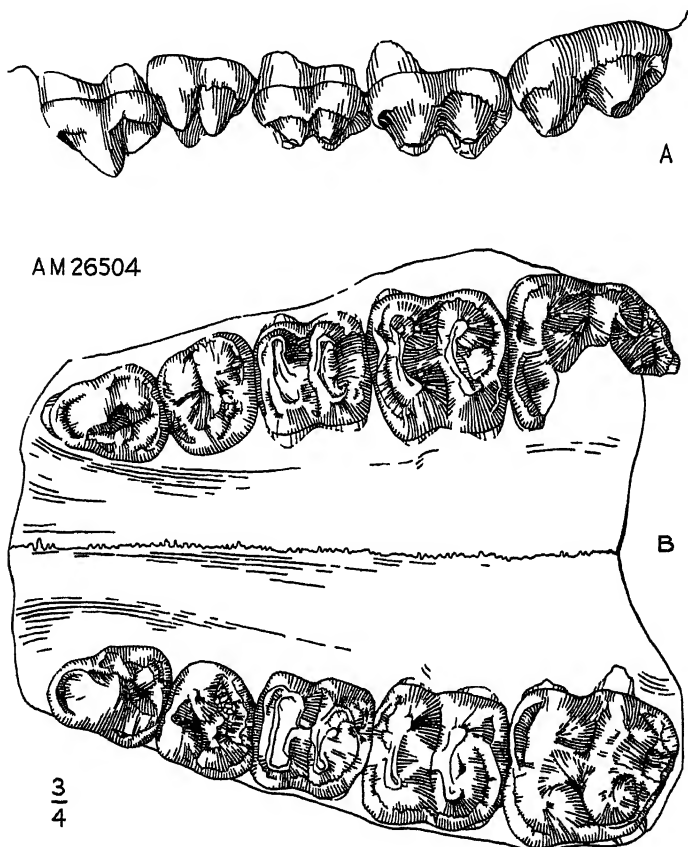


Fig. 1. *Listriodon mongoliensis*, new species. Type, Amer. Mus. No. 26504. Palate with P³-M³ on both sides. A, lateral view of left cheek teeth, with inner portion of M³ restored. B, crown view. Three-fourths natural size.

The fourth premolar consists of two outer cusps and an inner one, with antero- and postero-internal cingula. This tooth is almost quadrate in its outline, and its breadth considerably exceeds its length. As noted above, in the diagnosis of the species, the fourth premolar in *Listriodon mongoliensis* is characterized by the separateness of the two

outer cusps, which are divided by a cleft almost to the base of the crown, a feature that distinguishes this species from the other lophodont listriodonts. The form of this fourth premolar clearly shows an advance towards the molariform condition, for a transverse ridge connects the



Fig. 2. *Listriodon mongoliensis*, new species. Paratype, Amer Mus No. 26517. Fragmentary right maxilla with P²-M¹. Crown view. Three-fourths natural size

inner and the anterior outer cusp. One need only imagine the upgrowth of a second inner cusp from the already expanded postero-internal angle of the tooth, to realize the complete conversion of this last premolar into a double-crested grinder.

The molars need little elucidation. Each tooth consists of two transverse ridges, an anterior and a posterior cingulum, and in each tooth the posterior cingulum runs up to join the point of the postero-internal cusp (presumably the metaconule). In this last particular, *Listriodon mongoliensis* is different from the other species in the genus. The last molar is characterized by the narrowness of its posterior portion, and by the lack of a true talon.

TABLE OF MEASUREMENTS

Amer. Mus. No. 26504, type.

	Length	Width	Height
P ³	21 mm	17 5 mm.	17 mm.
P ¹	19	20	15
M ¹	21	21	14
M ²	25	25	15
M ³	30	27	17
Length of P ³ -P ¹		40 mm.	
Length of molar series		76	
Width of palate at P ³		31	
Width of palate at M ³		45	

Amer. Mus. No. 26517, paratype.

	Length	Width	Height
P ²	16 mm.	11 5 mm.	10 mm.
P ³	17	16	....
P ¹	19 5	14	.
M ¹		21 5	
Length of premolar series		49 5 mm	

THE PHYLOGENETIC DEVELOPMENT OF *LISTRIODON*

The genus *Listriodon* may be divided into two series, one of which is typified by strongly cross-crested, or lophodont, molars, having crowns of medium height, while the other series is characterized by its more typically suilline, bunodont, and low-crowned molars. Of course, this latter bunodont series, being more nearly like the primitive pigs, must be regarded as an unspecialized line derived from the stem forms, as opposed to the lophodont group which comprises really highly specialized suids. The relations of these two phylogenetic lines of *Listriodon* may be summarized in the following table.

	Bunodont series	Lophodont series
Lower Pliocene	<i>L. gigas</i> Pearson (Age unknown), China	<i>L. pentapotamiae</i> (Falconer) Lower Siwaliks, India <i>L. theobaldi</i> Lydekker Lower Siwaliks, India
Upper Miocene		<i>L. mongoliensis</i> , new species Tung Gur, Mongolia <i>L. splendens</i> (v. Meyer) Sarmatian, Europe
Middle Miocene	<i>L. guptai</i> Pilgrim Kamlial, India	↑
Lower Miocene	<i>L. affinis</i> Pilgrim Bugti, Baluchistan <i>L. latidens</i> (Biedermann) Burdigalian, Helvetian, Europe <i>L. lockharti</i> (Pomel) Burdigalian, Europe	
	↑	
	Ancestral form	

The close affinities between *Listriodon mongoliensis* and the typical European and Indian lophodont forms have been pointed out above. Recently a *Listriodon* has been described by Miss H. S. Pearson¹ from

¹Pearson, H. S. 1923. 'Chinese Fossil Suidae.' Pal. Sinica, Ser. C, IV, Fas. 5, pp. 7-11, figs. 1-4.

the Kansu district of China, and it is recorded as being from beds of an unknown age. This species, *Listriodon gigas*, is a bunodont form of tremendous size, and because of its departure from the typical lophodont development in the molars, Miss Pearson was inclined to regard it as a specialization from the bunodont series, but on a line quite separate from the other members of the genus. That *Listriodon gigas* is specialized cannot be denied; its great size, for instance, must be regarded as an advanced character. But from the structure of the teeth it seems logical to regard this species as a specialization along primitive lines of development, as exemplified particularly by *Listriodon affinis* and *Listriodon latidens*. Indeed, the step from *Listriodon latidens* to *Listriodon gigas* is not very great.

Thus we see that close comparisons between *Listriodon mongoliensis* and its nearest geographic neighbor, *Listriodon gigas*, can not be drawn. Both species must be regarded as late survivors of two phylogenetic lines that persisted in eastern Asia.¹

THE BEARING OF *LISTRIDON MONGOLIENSIS* ON THE AGE OF THE TUNG GUR BEDS

The two species of *Listriodon* most closely related to *Listriodon mongoliensis* are *Listriodon splendens* from the Sarmatian of Europe and *Listriodon pentapotamiae* from the lower Siwaliks of northern India. The European species is of Upper Miocene age (considering the Pontian as representing the lower phase of the Pliocene), while the Indian form must be considered as coming from the lower part of the Pliocene. However, we must bear in mind the fact that the entire Indian fauna represents the holdover of primitive forms into later periods, and thus we might expect a typically Miocene *Listriodon* to persist on into the Pliocene in the Siwalik series. The important fact to be remembered is that *Listriodon* is typically a Miocene, and therefore a pre-*Hipparion*, genus. On the basis of our present knowledge we recognize it persisting on into the Pliocene in India, where it is contemporaneous with *Hipparion*, and in China, where as a bunodont form it may even be of Pleistocene age.

Since the Tung Gur beds of Mongolia have yielded no *Hipparion*, and since other elements of that fauna have a distinct Miocene appearance, it would seem logical to assume that *Listriodon mongoliensis* is an Upper Miocene form, comparable in age to *Listriodon splendens* of Europe. The resemblances of *Listriodon mongoliensis* to the European and Indian

¹According to Miss Pearson, the age of *Listriodon gigas* is unknown. From its great size and the development of its teeth, it would seem to represent a late development in the history of the genus.

lophodont species would, in fact, point to the Tung Gur as being about Sarmatian in age, which in turn would be approximately correlative with the Pawnee Creek, the Barstow, the lower Snake Creek and the Mascall of North America.

This correlation of the Tung Gur is at variance with the previously published opinions, reached by the geologists of the Central Asiatic Expedition on the basis of field evidences, in which these beds were considered as entirely of Pliocene age.¹

It might be well to say in this connection, that the shifting of the Tung Gur formation from the Pliocene down to the Miocene is not an original idea formulated by the present author. Dr. Walter Granger, Palaeontologist of the Asiatic Expeditions, had reached the opinion some time ago, on the basis of his knowledge of the Tung Gur fossils, that the formation should properly be regarded as of Upper Miocene age. Thus the presence of *Listriodon* in the Tung Gur beds fully substantiates Doctor Granger's conclusions as to the Miocene age of the formation, thereby making it necessary for us to revise the earlier published opinions which regarded these sediments as of Pliocene affinities.

The foregoing conclusions as to the Miocene age of the Tung Gur formation have been approved by Doctor Spock and by Père Teilhard de Chardin, geologists of the Central Asiatic Expeditions for the years 1928 and 1930 respectively.

¹Spock, L. E. 1929. 'Pliocene Beds of the Iren Gobi.' Amer. Mus. Novitates, No. 394, pp. 4-6.
Spock, L. E. 1930. 'New Mesozoic and Cenozoic Formations Encountered by the Central Asiatic Expedition in 1928.' Amer. Mus. Novitates, No. 407, pp. 7-8.

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A NEW EMYDID TURTLE OF THE GENUS *Geoclemys* FROM KWANGTUNG PROVINCE, CHINA¹

BY CLIFFORD H. POPE

Geoclemys kwangtungensis, new species

Clemmys nigricans MELL, 1922, Archiv Naturg., LXXXVIII, Abt. A, Heft 10, p. 109 (Lofaoshan, 300–400 meters; Tinghushan, 400 meters; and Hsiaokeng, 400 meters; three Kwangtung localities) (not of Gray, 1834); 1929, 'Beiträg. Fauna Sinica,' IV, p. 192 (breeding) (not of Gray, 1834).

TYPE.—Berlin Museum No. 34955; adult, probably ♀; Lofaoshan, Kwangtung, 300–400 m. altitude; collected by R. Mell, August, 1916.

DESCRIPTION OF TYPE.—Head large, broad; snout pointed, projecting, its vertical profile oblique; edges of jaws not denticulate; upper jaw without hooks or median notch, its median, anterior profile concave; alveolar surface of both jaws very broad, without longitudinal ridges; bony choanae immediately posterior to orbits; mandibular symphysis slightly longer than diameter of eye; anterior part of head covered by a large, smooth shield on crown and snout, another on each side covering the whole temporal area; posterior upper surface of head with granular skin; shell moderately depressed, slightly wider posteriorly than anteriorly; carapace with a strong median keel; nuchal shield small, elongate, narrowed anteriorly, emarginate posteriorly; first vertebral pentagonal, much broader in front than behind, just as broad as the fourth but broader than the second, third, and fifth which are subequal in breadth; ninth marginal deepest, edges of third to eighth more or less turned up; posterior edge of carapace not serrated, almost smooth; plastron not concave, truncate in front, with a rounded notch behind; posterior lobe slightly broader than long, as broad as anterior lobe, distinctly narrower than opening of shell; entoplastron intersected by humeropectoral suture; abdominal suture longest, as long as pectoral and humeral sutures taken together; humeral suture shortest, pectoral equal to femoral and anal barely shorter than gular; axillary scarcely half as large as inguinal; toes webbed to tips.

Carapace chestnut brown, without pattern, traces of yellow evident along its margins and median lateral angles; plastron yellow, irregularly marked with chestnut brown which is most conspicuous laterally, anteriorly, and posteriorly; bridge chestnut brown; head uniform mahogany brown above, with fine, yellow vermiculations and a few irregular, narrow yellow stripes laterally; jaws and throat with dark spots and vermiculations; limbs and tail predominantly blackish, many of the shields on anterior aspect of fore limbs yellow and some yellow evident on the skin near the shell.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 121.

MEASUREMENTS

Greatest length of carapace	142.5 mm.
Greatest width of carapace	100.5
Greatest length of plastron	124
Length of hind lobe of plastron	48
Width of hind lobe of plastron	56.5
Width of bridge	42
Depth of shell	59.5
Width of head	30
Diameter of eye	10
Length of tail from vent	32

The measurements of the carapace do not take into consideration its curve.

The shell is worn smooth, so the type is undoubtedly quite mature.

G. kwangtungensis is best described as a southern, mountain relative of *G. reevesii*. The two species may be readily distinguished by the following table.

<i>reevesii</i>	<i>kwangtungensis</i>
Alveolar surface of jaws moderately wide.	Alveolar surface of jaws very wide.
Median anterior profile of upper jaw straight, or straight with a weak notch.	Median anterior profile of upper jaw concave.
Skin of posterior dorsal surface of head divided into small polygonal shields.	Skin of posterior dorsal surface of head granular.
Carapace with three longitudinal keels.	Carapace with a single median keel.
Lower jaw and sides of head with conspicuous yellow lines and markings.	Lower jaw and sides of head with relatively inconspicuous and weak yellow lines and vermiculations.

The bony choanae appear to be situated slightly more posteriorly in *kwangtungensis*, but this character is variable and difficult to determine.

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RECORDS OF AMERICAN BEMBICIDAE

BY HUGO G. RODECK¹

The following records are based on a small collection of unidentified Bembicidae loaned to me by The American Museum of Natural History.

Steniolia obliqua Cresson

IDAHO: Paris, June 8, 1920, one male (F. E. Lutz); Montpelier, July 6, 1920, two males (F. E. Lutz). WYOMING: Jackson, July 13-17, 1920, three males (F. E. Lutz). COLORADO: Electra Lake, June 28-July 1, 1919, two males (F. E. Lutz).

The specimens are all males and are all of rather large size (16-19 mm.) except one of the Montpelier, Idaho, specimens which measures only about 14 mm. It differs from the rest also in having the spine at the apex of the second abdominal sternite so much reduced as to be rather difficult to see, but otherwise it is similar.

Steniolia duplicata Provancher

NEVADA: Fallon, July 25, 1930, alt. 4000 ft., one female (E. L. Bell).

Bembix comata Parker

NEVADA: Fallon, July 27, 1930, alt. 4000 ft., two males (E. L. Bell).

The specimens are typical, although one of them has the fasciae on tergites 2 and 3 narrowly interrupted.

Bembix comata variety *nevadensis*, new variety

NEVADA: Fallon, July 1, 1930, alt. 4000 ft., two males (E. L. Bell).

MALE.—Small (14 mm.) and with no light markings whatever on the prothorax. Maculation of thorax and median segment limited to a spot on the tegulae which may be very inconspicuous. The paratype (13 mm. long) has the process on the second abdominal sternite reduced to a very low carina.]

Type in American Museum of Natural History, paratype in University of Colorado Museum.

As indicated by its small size and apparent seasonal isolation, this variety also may prove to be biologically distinct from the typical form.

¹University of Colorado Museum.

***Bembix sayi* Cresson**

COLORADO: Sterling, July 8, one male (Sandhouse).

***Bembix spinolae* Lepeletier**

COLORADO: Crook, Aug. 18 and Sept. 1, two females (Sandhouse). MICHIGAN: Douglas Lake, July 10 to August 18, 1913, numerous males and females (M. D. Ellis).

***Microbembex monodonta* (Say)**

COLORADO: Fruita, July 16, 1919, one male, at *Melilotus alba*, and one female (F. E. Lutz); Wray, July 17-19, 1919, three females (F. E. Lutz). NEVADA: Fallon, July 13, 1930, alt. 4000 ft., four males (E. L. Bell). WYOMING: Rock Springs, June 29, 1920, eleven males (F. E. Lutz).

A male from Fruita, Colorado, and one from Fallon, Nevada, have the lateral yellow spots of the second abdominal sternite produced mesad in such a way as to cover most of the process except the crest. One of the Rock Springs, Wyoming, specimens has a yellow spot on either side of the process.

The males from Rock Springs, Wyoming, seem to be rather distinct by possessing the following combination of characters:

No yellow markings on head. Frons, labrum, clypeus, orbits, antennae, all black except a very inconspicuous narrow line on upper posterior orbits, sometimes lacking. Lateral scutellar spots very narrowly interrupted or continuous. Fascia of first abdominal tergite with two small black median spots taking the place of an anterior emargination, or if an emargination is present it is more or less deeply bifid. Lateral yellow spots on sternites 2 and 3 usually reduced. Second sternal process generally highest at a point near the anterior of the crest, giving it the appearance of being tilted backward.

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NOTES ON AMERICAN LYCOSIDAE

BY W. J. GERTSCH

In spite of the fact that the wolf spiders or Lycosidae have always received a generous portion of the attention and interest of arachnologists, it was not until the publication of Chamberlin's 'Revision of the North American Spiders of the Family Lycosidae' in 1908 that anything resembling nomenclatorial stability was attained for the Nearctic species. In that fine monograph all the Hentzian names are established with some certainty, and valuable concepts, previously outlined, in the use of genitalia as a generic index, are utilized in the definition of genera. The total number of valid species considered in the paper was less than seventy. Recent collections have added enormously to the number of forms endemic to this region. At least twice as many are now known from the Nearctic region as were considered in the revision of 1908, and it would be fully within the limits of conservation to expect triple the number there described.

Opinion is still diverse as regards the use of certain specific names in the Nearctic Lycosidae. The founding by Walckenaer of a large number of species of American spiders on the colored drawings of John Abbot has decidedly impaired the normal development of a stable specific nomenclature. Some workers have argued that these names are invalid and have accepted them only when it was certain that specimens were actually on hand at the time Walckenaer wrote his descriptions. Such an opinion is untenable. The problem at hand is not the question of validity, which should be unchallenged, but one of recognition. Of the few names that have been placed, it can be said that they are used without any great amount of certainty. Fortunately, the Abbot Manuscript and drawings are still extant, and a study by students well versed in certain groups will ultimately solve the problem.

No general agreement has yet been reached in the controversy over the identity of the genotype of *Lycosa*. The name was first used in a generic sense by Latreille in 1804; and six years later, in 1810, he designated *Lycosa tarentula* as the type. There has been an overwhelming adherence to this concept by numerous European and American workers, notably Simon. On the other hand, it is held that the designation of this

species as type cannot be maintained, even when so used subsequently by the original author of the genus, because *tarentula* was not included in the group for which *Lycosa* was originally proposed. *Lycosa lugubris* was designated as type by Thorell in 1870. Its recognition would invalidate many names now used in both *Lycosa* and *Pardosa* and the latter would become a synonym. While I am sentimentally inclined to favor *tarentula* as the type, I should say that in my opinion the other side has much the better of the argument. However, in this paper the conventional American viewpoint is adhered to and *Pardosa* is used for the small species.

In this short paper an attempt has been made to place some of our species in what is regarded as their proper generic categories. The genus *Arctosa* is considered in its entirety and a key to the Nearctic forms is given. All of the species known from this region that conform to the genus *Tarentula* (*Alopecosa* Simon) are listed. In the other genera mentioned synonymical changes have been made in numerous instances, some of the sunken species are elevated to specific rank, and in addition important distributional data are recorded. *Pirata* is unquestionably the least known of the American genera. Some of the changes suggested in the nomenclature of this genus are opinionial, but the disposition of other names is based on the careful comparison of the types.

At this point it is of some importance to note that the lycosid types of Montgomery, with the exception of some of his species based on the Stone collection, are deposited in the collection of The American Museum of Natural History. A study of this material is directly responsible for some of the changes. Fortified with a large collection of European Lycosidae, acquired in exchange through the coöperation of Dr. E. Schenkel of Switzerland, I have been able to check the suggested synonymy of American forms by Emerton and Chamberlin. At least eight species are common to the Nearctic and Palearctic regions.

The genus *Allocosa* Banks, with *A. funerea* (Hentz) as the type, cannot be maintained separate from *Arctosa*. The genotype is the most divergent member of the group, but all intergrades between *A. funerea* and *A. littoralis* are known from the United States. The dark, shining carapace of *funerea* can be matched in such forms as *A. rubicunda* (Keyserling) and *A. sublata* (Montgomery). The reduction of the spines on the legs above is quite as true for species referred to *Allocosa* as in the other genus, the first two pairs being usually unarmed above and the last two with at most a single submedian spine above. The epigynae agree in lacking completely or in having a very weakly developed guide.

The palpi are even more significant as an index of relationship and such superficially different species as *funerea* and *littoralis* present similarities in structure that can scarcely be denied. In fact, on this basis such species as *Arctosa rubicunda*, *emertoni* and *quinaria*, not taking into consideration the substantial differences in the eye relations, are more remote from *cinerea* than is *funerea*. It is significant that F. O. P. Cambridge used *Arctosa* for species that were later relegated to *Allocosa*.

Of the fifteen species considered as belonging in *Arctosa* in this paper, only one is found in the Palearctic region. A comparison of four European species, including the genotype, further substantiates Chamberlin's separation of *littoralis* from *cinerea* and verifies Emerton's synonymizing of *Lycosa albobastata* with *Arctosa alpigena* (Doleschal). In addition to the inclusion in the genus of forms described in other groups, some species are regarded as new, and several changes in the conventional synonymy are made, notably the elevation of *sublata* and *noctuabunda* Montgomery to specific rank and the sinking of *rugosa* Keyserling as a synonym of *funerea*.

ARCTOSA C. Koch

C. KOCH, 1848, 'Die Arachniden,' XIV, p. 94. Type: *A. cinerea* (Fabricius).
Synonym: *Allocosa* Banks.

Allocosa N. BANKS, 1904, Proceedings Academy of Natural Sciences, Philadelphia, p. 537. Type: *A. funerea* (Hentz).

KEY TO THE NEARCTIC SPECIES OF *Arctosa*

- 1.—Second row of eyes much narrower than the first row. 2.
Second row of eyes about as broad or broader than the first row. 5.
- 2.—Legs distinctly annulate. *emertoni*, new species.
Legs light brown or black, without annulae. 3.
- 3.—Eyes of second row separated by nearly their diameter; legs and carapace black;
tibia and patella IV as long as carapace. *quinaria* (Emerton).
Eyes of second row separated by less than half their diameter. 4.
- 4.—Carapace dark brown to black, with no lighter markings; tibia and patella IV
shorter than carapace. *rubicunda* (Keyserling).
Carapace with light markings; tibia and patella IV about as long as carapace.
imperiola Gertsch.
- 5.—Carapace usually glabrous, shining, light to very dark brown, without light
markings. 6.
Carapace with lighter markings on the mid line or on the margins of
the carapace. 11.
- 6.—First two femora black, the remainder of these legs light, not annulate.
funerea (Hentz).
First two femora usually annulate, but when dusky, the rest of the legs annulate
or concolorous with the femora. 7.

- 7.—Males.....8.
Females.....9.
- 8.—Principal scopal process a slender, straight spur, directed ventrally; all legs annulate *chamberlini*, new species.
Principal scopal process a moderately stout, curved apophysis; first legs not annulate..... *mulaiki*, new species.
- 9.—Epigynal plate strongly rounded behind, the atriabursal orifices visible as two dark cavities on the surface of the plate..... *virgo* (Chamberlin).
Epigynal plate at most weakly rounded behind, the atriabursal orifices hidden by the caudal margin.....10.
- 10.—Caudal margin of epigynal plate straight; color of carapace dusky or black, shining..... *sublata* (Montgomery).
Caudal margin of epigynal plate gently rounded; carapace dark reddish-brown. *mulaiki*, new species.
- 11.—Males.....12.
Females.....16.
- 12.—Bulb with a prominent, sclerotized distal apophysis....13.
Bulb lacking a distal apophysis; scopus assymmetrically bifid. *alpigena* (Doleschal).
- 13.—Tibial joint of palpus nearly as long as the tarsus; size over 12 mm.; tibia and patella IV longer than carapace..... *littoralis* (Hentz).
Tibial joint of palpus no more than two-thirds as long as the tarsus; size usually less than 9 mm.; tibia and patella IV about as long as the carapace.....14.
- 14.—Principal scopal element broad, folded..... *parva* (Banks).
Principal scopal element a long, curved process.....15.
- 15.—Distal bulbal apophysis short, laterally directed... *noctuabunda* (Montgomery).
Distal bulbal apophysis long, caudally directed to touch the scopus. *mokiensis*, new species.
- 16.—Epigynal plate with broad openings separated by a weakly indicated guide. *littoralis* (Hentz).
Epigynal plate without openings on the plate proper, the atriabursal orifices at the caudal margin.....17.
- 17.—Caudal margin of epigynal plate bilobate..... *parva* (Banks).
Caudal margin nearly straight.....18.
- 18.—Tibia and patella IV slightly shorter than the carapace, which is moderately hairy; sternum black..... *alpigena* (Doleschal).
Tibia and patella IV as long as the carapace, which is nearly glabrous; sternum light..... *noctuabunda* (Montgomery).

Arctosa alpigena (Doleschal)

Trochosa insignita THORELL, 1872, Ofvers. K. Vet. Akad. Forh., XXIX, p. 160.

Lycosa albohastata EMERTON, 1894, Trans. Connecticut Academy Arts and Sciences, IX, p. 423, Pl. III, fig. 3.

Lycosa albohastata CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 275, Pl. XIX, fig. 1.

Lycosa alpigena EMERTON, 1921, Psyche, XXVIII, p. 168.

RECORDS.—Nain, Labrador, July 3, 1922. Yellowstone National Park, August, 1931 (W. E. Gertsch). Sharon, Idaho, August 17, 1931 (Gertsch). Albuquerque, New Mexico. Hudson Bay, Great Whale River to Richmond Gulf, August, 1920 (Johansen). Lac Seul, Ontario (Waugh). Southern Labrador, Macativa to Sandy Islands, July, 1915 (Townsend). President Mountain, 8000 feet, near Alpine Club Camp, Alberta, August, 1914 (Emerton). North Devon Island, Hudson Bay, August 13, 1904. Spring Lake, Hudson Bay, July 10, 1917.

***Arctosa quinaria* (Emerton)**

Lycosa quinaria EMERTON, 1894, Trans. Connecticut Academy Arts and Sciences, IX, p. 422, Pl. III, fig. 5.

Lycosa quinaria CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 277, Pl. XIX, fig. 7.

RECORDS.—Edmonton, Alberta.

***Arctosa imperiosa* Gertsch**

Arctosa imperiosa GERTSCH, 1933, American Museum Novitates, No 637, pp. 13-14, Fig. 17

RECORDS.—Colorado Springs, Colorado, July (type locality). Pikes Peak, Colorado (Cockerell). Ouray, Colorado (Lutz).

***Arctosa rubicunda* (Keyserling)**

Trochosa rubicunda KEYSERLING, 1876, Verh. Zool.-Bot., Gesell. Wien, XXVI, p. 663, Pl. II, fig. 40.

Lycosa polita EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 484, Pl. XLVI, fig. 2 (not "spotted form").

Lycosa rubicunda CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 278, Pl. XIX, fig. 9 (part).

RECORDS.—Norwalk, Connecticut, July 20-28, 1933; May 25-27, 1933 (Gertsch).

***Arctosa emertoni*, new species**

Lycosa polita EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 484, Pl. XLVI, fig. 2a (variety with spots).

MALE.—Total length, 7.66 mm. Carapace 4.10 mm. long, 3.00 mm. wide, 1.70 in front. Abdomen 3.66 mm. long, 2.42 mm. wide.

Cephalothorax provided with a very sparse covering of short hairs and weak spines, the eye area being comparatively heavily clothed with white hairs. Clypeal margin with four long spines. Integument of the carapace bright yellowish-brown, the eyes on a black field, medially with a light band at each side of which is a broad dusky band that extend. to the caudal margin and includes the sides of the pars cephalica.

Margins of the carapace with a broken, narrow dark band. Mouth parts, sternum and coxae light yellowish-brown, concolorous with the integument of the legs, which are distinctly annulate, the rings usually broken below and sometimes above. Abdomen dark above, showing no pattern, the venter somewhat lighter.

First row of eyes broader than the second (33/26), the medians slightly larger, two-thirds of a diameter apart, half as far from the laterals. Clypeus as wide as two-thirds the diameter of an anterior median eye, which is the same distance from the eye of the second row. Eyes of the first row very slightly recurved, as seen from in front, more so as viewed from above. Eyes of the second row larger than the anterior medians (10/8), separated by their diameter, slightly farther from the eyes of the third row, which are smaller (10/8). Third eye row narrower than the second (26/43), the eyes separated by three diameters. Chelicerae armed with three subequal teeth on the lower margin, and three on the upper, of which the middle one is larger.

Legs stout, the first tibiae with 2-2-2 spines beneath, the second with 1-2-2, the metatarsi with three pairs of strong spines. First two tibiae unarmed above, the last two with a stout median spine and either a basal bristle or a very weak spine.

Tibia and patella I, 4.80 mm. long.

Tibia and patella IV, 5.33 mm. long.

Palpus very close to that of *Arctosa rubicunda* (Keyserling), the differences being chiefly in the scopus, which is a short straight black spur in *rubicunda* but strongly curved in *emertoni*.

FEMALE.—Total length, 11.30 mm. Carapace 5.00 mm. long, 3.90 mm. wide, 1.80 mm. in front. Abdomen 7.00 mm. long, 4.66 mm. wide.

Color, structure, eye relations and spines as in the male.

Tibia and patella I, 4.00 mm. long.

Tibia and patella IV, 4.43 mm. long.

Epigynum indistinguishable from that of *Lycosa polita* as figured by Emerton.

TYPE LOCALITY.—Male holotype, female allotype, and male and female paratypes from Wacouta Beach, Lake Pepin, Minnesota, May 15, 1932 (Gertsch); male and female paratypes from St. Thomas, Ontario (L. E. James).

The species described by Keyserling is the one in which the dark carapace is smooth and shining, entirely devoid of hairs or spines. Emerton's types are of both species: one which was described in more detail as "without spots," from Blue Hills, Boston, Massachusetts, I regard as the type and a synonym of *rubicunda*: and the other is the variety "with spots," from Albany, New York. Both have been regarded as identical by subsequent writers, but a comparison shows they are specifically distinct. I have males and females of the dark variety from Norwalk, Connecticut, taken from May to August.

ADDITIONAL RECORDS.—Lanoraie, Quebec, June 24, 1915 (Beaulne). Montreal, Quebec, May 8, 1915 (Beaulne). Hudson, Quebec, May 21, 1915 (Beaulne). Awene, Manitoba, October 16, 1917 (Criddle). Ottawa, Ontario, April 28, 1912 (Beaulne).

Arctosa littoralis (Hentz)

Lycosa littoralis HENTZ, 1844, Journ. Boston Soc. Natural History, IV, p. 388, Pl. xvii, fig. 9.

Lycosa cinerea CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 281, Pl. xx, figs. 5 and 6.

Arctosa littoralis CHAMBERLIN, 1924, Proc. California Academy Sciences, (4) XII, pp. 673-674.

This widely distributed species is found from coast to coast and from Mexico far north into Canada. I have found it running freely along the margins of rivers and lakes in Minnesota in company with *Arctosa emertoni*. Under suitable conditions it digs a burrow ten inches or more in depth, the ones that I have seen being in soft sand along the Mississippi River near Minneapolis, Minnesota. The following cited localities will give some idea of its general occurrence in the Nearctic region.

RECORDS.—Los Angeles, California. Chisos Pass. Brewster County, Texas (Montgomery). Austin, Texas (Montgomery). Grand Gulch, Utah. Utah Lake, Utah, July. Palilo Beach, Florida, March 4. Lake Pepin, Minnesota, May 15, 1932 (Gertsch). Lake Minnetonka, Minnesota, June 2, 1932 (Gertsch). Cold Spring Harbor, Long Island, New York (Montgomery). Woods Hole, Massachusetts. Canada. Arnprior, Ontario. Lac Seul, Ontario, August 1, 1919 (Waugh). Lanoraie, Quebec, July 5, 1915, June 25, 1915 (Beaulne). Ironside, Quebec, October 21, 1915 (Stohr).

Arctosa sublata (Montgomery)

Lycosa sublata MONTGOMERY, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 539, Pl. xxix, fig. 2.

Allocosa funerea CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 287, Pl. x, fig. 3 (error in synonymy).

RECORDS.—Kingston, Tennessee, July 10-12, 1933 (Gertsch).

Arctosa virgo (Chamberlin)

Allocosa virgo CHAMBERLIN, 1925, Bulletin Museum of Comparative Zoölogy, LXVII, p. 226.

RECORDS.—Baltimore, Maryland. Rockbridge, Ohio, June 17, 1922 (Barrows).

Arctosa noctuabunda (Montgomery)

Trochosa noctuabunda MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 301, Pl. xviii, figs. 9 and 10.

Allocosa degesta CHAMBERLIN, 1904, Canadian Entomologist, XXXVI, p. 287.

Allocosa degesta CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 288, Pl. x, figs. 1 and 2.

Allocosa pylora CHAMBERLIN, 1925, Bulletin Museum of Comparative Zoölogy, LXVII, p. 226.

RECORDS.—Austin, Texas (Montgomery). Llano County, Texas (Montgomery). Florida.

***Arctosa mokiensis*, new species**

Arctosa noctuabunda GERTSCH, 1933, American Museum Novitates, No. 637, p. 8, fig. 11 (not *noctuabunda* Montgomery).

MALE.—Total length, 3.80 mm. Carapace 2.66 mm. long, 2.06 mm. wide, .93 mm. in front. Abdomen 2.26 mm. long, 1.60 mm. wide.

Cephalothorax clothed with a few short hairs and spines, the eye area with black hairs and four long spines on the clypeal margin and an additional one between the anterior median eyes. Carapace light brown in color, lightest at the middle, somewhat infuscated on the sides. Sternum, labium, endites and coxae light yellowish-brown, all clothed with black hairs and a few spines. Legs concolorous with the coxae, the last pair of legs with inconspicuous annulae on the femora. Abdomen light, showing no pattern.

First eye row narrower than the second (20/23), the slightly larger median eyes separated by two-thirds of a diameter, half as far from the laterals. Second row of eyes narrower than the third (23/29), the eyes two-thirds of a diameter apart, larger than the anterior medians (9/4), larger than the eyes of the last row (9/6.5) and about twice as far away from them. Posterior ocular quadrangle broader than long (29/23), narrower in front in the same ratio. Clypeus equal in height to two-thirds the diameter of an anterior median eye. Chelicerae with three teeth on the lower margin.

Legs moderately stout, the first and last tibiae with 2-2-2, the second and third with 1-2-2 spines beneath, the metatarsi with three pairs. Tibiae of the first two pairs of legs lacking spines above, the last two with a submedian spine.

Tibia and patella I, 3.00 mm.

Tibia and patella IV, 3.80 mm.

Palpus very close to others in the *Allocosa* group and separable from that of *Arctosa noctuabunda* (Montgomery) by characters of the median apophyses of the bulb. The principal scopal element is identical in both species, a heavy ventrally curved spine, but the processes beneath the scopus are different. In *noctuabunda* the inferior scopal element is a heavy, short tooth. The homologous structure in *Arctosa mokiensis* is a slender, long spine. The distal apophysis of the bulb is very similar in these two species as well as in others of the group [*funerea* (Hentz), *apora*, new species, *parva* (Banks), etc.] but the caudally projecting spur is much longer in *mokiensis* than in any of the other species.

TYPE LOCALITY.—Male holotype from Indian Gardens, Grand Canyon, Arizona, May 26, 1905.

***Arctosa apora*, new species**

MALE.—Total length, 5.25 mm.

Carapace 2.75 mm. long, 2.00 mm. wide, 1.10 mm. in front. Abdomen 2.70 mm. long, 1.62 mm. wide.

Cephalothorax smooth and shining, the eye area well provided with erect spines and short hairs, the clypeal margin with five prominent spines. Labium, endites, sternum and coxae dull yellowish-brown, concolorous with the legs, which are indistinctly annulate. Abdomen bright yellow above, the sides dark, the venter lighter.

First row of eyes narrower than the second (21/25), very weakly procurved, the larger medians separated by one-half their diameter, half as far from the laterals. Clypeus about as high as the diameter of an anterior lateral eye. Second row of eyes narrower than the third (25/29), separated by three-fourths of a diameter, slightly over a diameter from the smaller posterior eyes (10/7). Posterior ocular quadrangle broader than long (29/22), slightly narrower in front, the posterior medians separated by a little more than two diameters. Chelicerae with three teeth on the lower margin, the inner one minute.

Legs stout, the spines as in *chamberlini*, new species.

Tibia and patella I, 2.35 mm. long.

Tibia and patella IV, 2.80 mm. long.

Palpus of the *Allocosa* type, differing from all other species in the modification of the cymbium. In the typical members of the genus the cymbial margins are rounded, but in *apora* the retrolateral basal margin is expanded into a lobe that projects ventrally and partially covers the scopal elements. The principal spur of the scopus, long in the other species, is reduced to a short spine and is exceeded in length by the inferior apophysis. The distal bulbal apophysis is elongated as in *mokiensis*.

Two females from the same collection may belong with the above described male, but they are identical in every respect, including the bilobate epigynum, with *Arctosa parva* (Banks).

TYPE LOCALITY.—Male holotype from San Jose, Costa Rica.

Arctosa parva (Banks)

Trochosa parva BANKS, 1894, Journal New York Entomological Society, II, p. 52.

Arctosa parva F. CAMBRIDGE, 1902, 'Biologia Centrali-Americana,' Arachnida, Araneidea, II, p. 332.

Allocosa parva CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 289, Pl. xx, fig. 7.

RECORDS.—San Francisco, California. Las Vegas, Nevada.

Arctosa funerea (Hentz)

Lycosa funerea HENTZ, 1844, Journal Boston Soc. Natural History, IV, p. 393, Pl. xviii, fig. 11.

Lycosa rugosa KEYSERLING, 1876, Verh. Zool.-Bot., Gesell. Wien, XXVI, p. 624, Pl. i, figs. 9 and 10.

Pardosa nigra STONE, 1890, Proc. Acad. Nat. Sci. Philadelphia, p. 432, Pl. xv, fig. 4.

Allocosa funerea CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 287, Pl. x, fig. 3.

RECORDS.—Kingston, Tennessee, July 10-15, 1933, "common under stones" (Gertsch and Ivie).

***Arctosa mulaiki*, new species**

MALE.—Total length, 4.60 mm. Carapace 2.72 mm. long, 1.92 mm. wide, 1.00 mm. in front. Abdomen 2.00 mm. long, 1.50 mm. wide.

Cephalothorax smooth and shining, devoid of hairs or spines except on the clypeal margin, dark reddish-brown in color, the eye area black. Margin of the pars thoracica with a narrow black line. Sternum light yellowish-brown, medially with a light streak, clothed sparsely with black hairs on the margins. Labium light brown, the endites lightened distally. The first two pairs of legs light yellowish-brown, without annulae, the femora dusky. Last two pairs of legs with basal and distal black annulae on the tibiae, the femora infuscated, the distal joints light brown. Abdomen dark on the sides, the dorsum with a medial basal orange, hastate marking, followed by broken black chevrons, the venter paler.

First row of eyes as wide as the second, the eyes subequal, the medians separated by two-thirds of a diameter, half as far from the laterals. Clypeus three-fourths as high as the diameter of an anterior lateral eye. Eyes of the second row separated by two-thirds of a diameter, twice as far from the eyes of the third row, which are separated from each other by about two and one-half diameters. Chelicerae with three teeth on the upper and three on the lower margin of the furrow.

Legs stout, all the tibiae and metatarsi with three pairs of spines beneath, the last two tibiae armed above with a submedian spine, the first two without spines.

Tibia and patella I, 2.25 mm. long.

Tibia and patella IV, 2.62 mm. long.

Palpus identical in structure with that of *Arctosa noctuabunda* (Montgomery).

FEMALE.—Total length, 6.20 mm. Carapace 2.75 mm. long, 2.08 mm. wide, 1.32 mm. in front. Abdomen 3.45 mm. long, 3.00 mm. wide.

Coloration as in the male, except for the legs, which are darker and show traces of annulae on the tibiae of the first two pairs. Eyes arranged as in the male, the first row about equal to the second in width, the third row broader (27/21). The epigynum is very close to that of *A. noctuabunda*, the principal difference being in the gently rounded caudal margin, which is straight in the other species.

Female holotype, and male allotype from Edinburgh, Texas, collected by Mr. Stanley Mulaik for whom the species is named.

Arctosa mulaiki is distinguished from the closely allied *A. noctuabunda* by the following characters. The carapace is much more convex, proportionately shorter, the head broader, and in addition lacks the lighter dorsal and marginal markings always present in the other species. In the male of this new form the first legs are unbanded and the tibia and patella of the fourth pair is slightly shorter than the carapace, slightly longer in *noctuabunda*.

***Arctosa chamberlini*, new species**

MALE.—Total length, 4.33 mm. Carapace 2.06 mm. long, 1.50 mm. wide, .70 mm. in front. Abdomen 2.16 mm. long, 1.46 mm. wide.

Cephalothorax smooth and shining, utterly devoid of spines or hairs except on the margins, the clypeus with four stout spines. Carapace black, lightened slightly

above, behind the last row of eyes. Sternum and labium black, the endites, coxae and legs bright yellowish brown. Legs and underparts of the cephalothorax clothed very sparsely with black hairs. Legs with a median and distal ring on the femora and a sub-basal and distal dark ring on the tibiae and metatarsi, otherwise unmarked. Abdomen light brown above and below, the sides darker, the venter with a few dark spots.

First row of eyes narrower than the second (13/16), slightly procurved, the medians considerably larger, separated by two-thirds their diameter, half as far from the laterals. Eyes of the second row larger than the anterior medians (7/3), separated by five-sevenths of a diameter, twice as far from the eyes of the last row, which are a little more than three diameters apart. Posterior ocular quadrangle broader than long (20/17), slightly narrowed in front in the same ratio. Clypeus equal in height to the diameter of an anterior lateral eye. Chelicerae armed above and below with three teeth, the middle one of which is larger.

Legs stout, the first tibiae with 2-2-2 spines, the second with 1-2-2 beneath, the metatarsi with three pairs. First two tibiae without spines above, the last two with a single median spine.

Tibia and patella I, 1.60 mm. long.

Tibia and patella IV, 2.00 mm. long.

Palpus of the *Allocosa* type, closely related to *funerea* (Hentz), *noctuabunda* (Montgomery) and *parva* (Banks). The scopal element is divided into two parts as in *parva* but the principal one is not as large or bent so strongly caudad as in that species. In the other species mentioned this process is considerably larger and curved strongly ventrad. The annulate femora immediately separate this new species from *funerea* in which the femora are always black and the distal joints of the anterior legs are light.

TYPE LOCALITY.—Male holotype from Vernal, Utah, November 20, 1930 (O. H. Robinson, collector).

Arctosa floridiana (Banks)

Trochosa floridiana BANKS, 1893, Trans. American Entomological Society, XXIII, p. 72.

Lycosa floridiana CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 283 (not *Lycosa floridiana* Banks).

Arctosa seminola PETRUNKEVITCH, 1911, Bulletin American Museum Natural History, XXIX, p. 552.

This species is not included in the key. The types are females and are well-marked examples of the genus *Arctosa*.

Pirata Sundevall

GENOTYPE.—*Pirata piraticus* (Clerck).

Pirata arenicola Emerton

Pirata aspirans CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 303, Pl. XXII, fig. 5. (male, not female type).

Pirata arenicola EMERTON, 1909, Trans. Connecticut Academy Arts and Sciences, XIV, pp. 208-209, Pl. VI, fig. 9.

Pirata maculatus EMERTON, 1909, idem, p. 209, Pl. VI, fig. 10.

Pirata insularis Emerton

Pirata insularis EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 492, Pl. XLVIII, fig. 8.

Pirata lber MONTGOMERY, 1902, Proc. Acad. Nat. Sci. Philadelphia, p. 578, Pl. XXX, figs. 42 and 43.

Pirata insularis CHAMBERLIN, 1908, idem, p. 309, Pl. XXII, figs. 3 and 4 (male, not female).

Pirata sylvestris EMERTON, 1909, Trans. Connecticut Academy Arts and Sciences, XIV, p. 209, Pl. VI, fig. 8 (male, not female).

Pardosa bilobata Tullgren and *Pirata montanoides* Banks are probably properly placed as a synonyms of this species.

Pirata minutus Emerton

Pirata minutus EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 493, Pl. XLVIII, fig. 10.

Pirata exiguus BANKS, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 72, Pl. I, fig. 48.

Pirata humicola MONTGOMERY, 1902, idem, p. 575, Pl. XXX, figs. 40 and 41.

Pirata prodigiosa Keyserling

Pirata prodigiosa KEYSERLING, 1876, Verh. Zool.-Bot., Gesell. Wien, XXVI, p. 669, Pl. II, fig. 44.

Lycosa febriculosa BECKER, 1881, Comptes-Rendus Soc. Entom. Belgique, p. XLV, Pl. II, fig. 2.

Lycosa wacondana SCHEFFER, 1904, Entomological News, Philadelphia, XV, p. 260, Pl. XVII, fig. 7.

Pirata sylvestris EMERTON, 1909, Trans. Connecticut Academy Arts and Sciences, XIV, p. 209, Pl. VI, fig. 8. (Female ?)

Pirata sedentarius Montgomery

Pirata sedentarius MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 312, Pl. XIX, figs. 28 and 29.

This species is distinct from *P. febriculosa*, with which it has been synonymized. It is a very common species in Tennessee and Texas.

Pirata gigantea, new species

FEMALE.—Total length, 5.30 mm. Carapace 3.00 mm. long, 2.12 mm. wide, 1.20 mm. in front. Abdomen 2.66 mm. long, 1.66 mm. wide.

Cephalothorax sparsely clad with short black hairs, the black eye region with numerous long, weak spines. Integument of the carapace yellowish brown, with two broad longitudinal brown bands, between which is a median lighter band and forward in the eye region the customary *Pirata* light markings. Sides of the carapace with a broad, irregular, marginal light band. Sternum and mouth parts infuscated, little darker than the unmarked legs, which are clothed with black hairs and strong spines. Abdomen dark above, with a median basal lighter marking, the venter lighter.

Eyes of the first row slightly narrower than the second (23/27), straight, the medians two-thirds of a diameter apart, slightly nearer the smaller laterals. Second row much narrower than the third (27/38), the eyes separated by seven-tenths of a diameter, a diameter from the smaller eyes of the third row. Posterior ocular quadrangle much broader than long (23/38). Clypeus scarcely as high as the diameter of an anterior lateral eye. Chelicerae with three teeth on the lower margin.

Legs long, provided with strong spines, the first tibia with 2-2-0 beneath, the distals missing, the pair often regarded as ventral are here considered as lateral, the other tibiae with 2-2-2 beneath. Tibiae of the first two legs lacking true spines above, a basal and submedian bristle often present, the last two pairs with a true basal and a submedian spine above.

Tibia and patella I, 3.00 mm.

Tibia and patella IV, 3.70 mm.

Epigynum scarcely half as broad as the sternum, a conspicuous black plate somewhat broader than long, broadly rounded caudally and with a median groove dividing it into two equal lobes as in *P. insularis* Emerton. Between the lobes are two rounded tubercles, separated by scarcely a diameter. In *P. insularis* the homologous structures are nearer the caudal margin and are widely separated. That species further differs in having a marginal black band on the carapace.

TYPE LOCALITY.—Female holotype and paratypes from near Chicago, Illinois, June 13.

The generic name *Tarentula* should be used for the species referred to *Alopecosa* by some American authors. At least six species conform to the definition of that genus and are in full agreement with those referred to it by Reimoser in his 'Katalog der Echten Spinnen des Paläarktischen Gebietes' (Abhandlungen der Zool.-Bot., Gesellschaft in Wien, Band X, heft 2 (1919)). In addition to the more important differences in the genitalia demarking this group from other genera, the species may be recognized by their having two teeth, rather than the conventional three, on the lower margin of the cheliceral furrow. A single American species, *Trochosa pratensis*, other than those commonly referred to *Alopecosa*, has the same armature, but it can scarcely be confused with the other group. *Lycosa beani* Emerton is identical with *Tarentula aculeata* of Europe. Of the nine Siberian members of *Tarentula*, described by Kulczynski in 1908, one is reported with some degree of certainty as belonging to the Nearctic fauna. It is to be expected that many more will be found to be common to both areas.

TARENTULA Sundevall

Tarentula aculeata (Clerck)

Aranea aculeata CLERCK, 1757, 'Aranei Suecici,' Stockholm.

Lycosa beani EMERTON, 1894, Trans. Connecticut Academy Arts and Sciences, IX, p. 421.

DISTRIBUTION.—Europe, Siberia, and northern North America.

RECORDS.—Minneapolis, Minnesota, May, 1932 (Gertsch). Itasca Park, Minnesota, May 29–30, 1932 (Gertsch). Medicine Hat, Alberta, August 16, 1930. Saskatoon, Saskatchewan. Banff, Alberta, June, 1919 (Sansou). Lac Seul, Ontario, 1919 (Waugh). Lake of the Woods, August 19, 1924 (Waugh). Isle Haute, N.S., 1921 (Townsend). Long Peak, Colorado. Yellowstone National Park, Wyoming, August, 1930 (W. E. Gertsch).

***Tarentula asivak* (Emerton)**

Lycosa asivak EMERTON, 1919, 'Canadian Arctic Expedition of 1913–1918, III, Insecta, part H, pp. 5H–6H, Pl. II, figs. 13–16.

RECORDS.—Bernard Harbor, N. W. T., July 12, 1915, August 17, 1915, May 3, 1916, May 21, 1916 (Johansen). Young Point, N. W. T., July 18, 1916 (Johansen). Lake Harbor, Baffin Land, August 23, 1927 (Johansen). Cape Barrow, Arctic Canada, August 14. West of Kongegevik, Camden Bay, July 4, 1914 (Johansen).

***Tarentula exasperans* Cambridge**

Tarentula exasperans CAMBRIDGE, 1877, Annals and Magazine of Natural History, London, (4) XX, p. 283, Pl. VIII, fig. 7.

Lycosa exasperans EMERTON, 1921, Psyche, XXVIII, p. 167.

The specimens from Saunders Island, on the west coast of Greenland, taken by members of the Crocker Land Expedition of 1917 and mentioned by Emerton in the above publication, are not now in the collection of The American Museum of Natural History. However, a male and female from Umanak, Greenland, taken in June, 1914, by Ekblau and Tanquary and labelled *pictilis* by Emerton, is this species. It is a typical *Tarentula* and was compared by Emerton with *pictilis*, *mutabilis* and *poecila*. He says: "it seems probable that comparison of a larger number of specimens would show that all these are one species extending across the Arctic coast from Siberia to Greenland and south through Labrador to the White Mountains." While not admitting that the names enumerated above are synonyms, I believe it quite probable that Siberian forms will be found in northern Canada and that some of the species already described from America occur in Siberia. *Tarentula albostrigata* Grube is closely allied to *exasperans*.

Tarentula kochi Keyserling

Tarentula kochii KEYSERLING, 1876, Verh. Zool.-Bot., Gesell., Wien, XXVI, p. 636, Pl. I, fig. 18 (nec *Lycosa kochii* Emerton).

Lycosa bruneiventris BANKS, 1894, Journal New York Entomological Society, II, p. 50.

Lycosa kochi CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 263, Pl. XXI, figs. 4 and 5.

Pardosa heretica CHAMBERLIN, 1925, Proc. California Academy Sciences, (4) XIV, pp. 125-126, Fig. 37.

Tarentula kochi is the commonest larger Lycosid found in the spring months in the Rocky Mountain region. It has been reported from the Eastern States but this may be an error. Some of these records probably refer to *aculeata* which is common in Minnesota and the northern Mississippi basin.

Tarentula pictilis (Emerton)

Lycosa pictilis EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 485, Pl. XLVI, fig. 5.

Lycosa pictilis CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 270, Pl. XIX, figs. 6 and 8.

DISTRIBUTION.—“*L. pictilis* is found on the Mt. Washington range above trees up to the highest summits, on the coast of Labrador and on the arctic coast of Canada.” (Emerton, 1921, Psyche, XXVIII, page 167.)

RECORDS.—Bernard Harbor, 1915. Mouth of Coppermine River, N. W. T., June 16, 1925 (Hoare). Hudson Bay, Great Whale River to Richmond Gulf, August, 1920 (Johansen). Barter Islands, Alaska.

Tarentula mutabilis Kulczynski

Tarentula mutabilis KULCZYNSKI, 1908, Memoires de l'Academie Imperiale des Sciences de St.-Petersbourg, (8) XVIII, No. 7, p. 85, Tab. III, figs. 96-101.

RECORDS.—Colville River, Alaska, 1909 (Anderson) (immature female). Flaxman's Island, Alaska, 1909 (Anderson) (female).

PARDOSA C. Koch

GENOTYPE.—*P. striatipes* C. Koch.

In the following consideration of this genus various nomenclatorial changes are proposed. Many names are regarded as synonyms of described forms, some have been placed in different relationships, and a few, previously synonymized, have been considered as good species. *Pardosa ontariensis* Gertsch was based on a male of *P. coloradensis* Banks, which latter name had been synonymized with *P. sternalis* (Thorell) in 1908. The presence of two additional Palearctic species in

the Nearctic fauna is of considerable interest. It seems worth while at this time to give locality data on some of the American members of the genus and report several species, originally described from Mexico, that are found in the southwestern states. *Pardosa retrorsa* Banks is probably a *Schizocosa*. *Pardosa heretica* Chamberlin is a *Tarentula*.

***Pardosa tesquorum* (Odenwall)**

Lycosa tesquorum ODENWALL, 1901, Öfversigt af Finska Vetenskaps-Societeten's Forhandlingar, XLIII, p. 4, Figs. 5 and 6.

Pardosa albiceps EMERTON, 1915, Trans. Connecticut Acad. Arts and Sciences, XX, pp. 153-154, Pl. III, fig. 5.

RECORDS.—James Bay, Moose and Albany Rivers, July, 1920 (Johansen). Awene, Manitoba, September 24, 1917 (Criddle). Mondike Valley, Dawson Rock Creek. Spray River, B.C., July 4, 1914 (Sanson). Medicine Hat, Alberta, September. Yellowstone National Park, Wyoming, August, 1932 (W. E. Gertsch). Panguitch, Utah (Ivie).

***Pardosa metlakatla* Emerton**

Pardosa metlakatla EMERTON, 1917, Canadian Entomologist, XLIX, p. 268, Fig. 20 (3 and 4).

Pardosa hesperella CHAMBERLIN, 1919, Pomona College Journal of Entomology and Zoölogy, XII, p. 16, Pl. VI, fig. 4.

RECORDS.—This species has been recorded from British Columbia in Canada and from Montana in the United States.

***Pardosa coloradensis* Banks**

Pardosa coloradensis BANKS, 1894, Journal New York Entomological Society, II, p. 51 (female).

Pardosa sternalis CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 185, Pl. VIII, figs. 7 and 9, Pl. XIII, figs. 5 and 6. (Part.)

Pardosa ontariensis GERTSCH, 1933, American Museum Novitates, No. 636, p. 18, Fig. 27 (male).

Males and females taken together in Utah and Wyoming by Mr. Wilton Ivie show that the female described by Banks as *coloradensis* goes with the male *ontariensis*. The females of the species were regarded by Chamberlin in 1908 as representing an immature form of the common western *Pardosa sternalis* (Thorell).

***Pardosa andersoni*, new species**

FEMALE.—Total length, 6.00 mm. Carapace 3.00 mm. long, 2.33 mm. wide. Abdomen 3.13 mm. long, 2.00 mm. wide.

Cephalothorax and legs covered with short appressed hairs, the clypeus with long slender spines. Carapace dark brown, medially with a narrow lighter stripe that goes

forward to the last eye row, the margins with a broader, light submarginal stripe and a dark marginal band. Sternum and labium dark brown, the endites and coxae lighter. Legs dark brown, the femora with black streaks above. Abdomen dark brown, the sides with indistinct black markings.

First row of eyes narrower than the second (20/32), slightly procurved, the medians separated by a diameter, half as far from the subequal laterals. Clypeus twice as high as the diameter of an anterior median eye. Second row of eyes narrower than the third (32/42), scarcely a diameter apart, one and one-half diameters from the smaller eyes of the third row.

Tibia and patella I, 2.90 mm.

Tibia and patella IV, 3.60 mm.

Spines under the tibiae, 2-2-2.

The epigynum is a heavily sclerotized, dark reddish-brown plate as broad as long, narrowed in front to about half the width and medially indented at that point, the caudal margin truncate. The plate is imperforate on the surface, the atrio-bursal orifices being located at each side of the caudal margin, the position indicated by a darker chromatism. The epigynum of *andersoni* closely resembles that organ in various European species but is not identical with any with which it has been compared (e.g., *Pardosa saltuaria*, *blanda*, *monticola*, *agrestis*, *torrentum*, *mixta*, and *tarsalis*). It can scarcely be confused with *hyperborea* Thorell, which is also European, or with *californica* Keyserling, the only American species possessing this type of epigynum. In both these species the openings are on the sides. *P. hyperborea* is considerably smaller and has very broad, marginal lighter stripes on the carapace. The median light stripe in *californica* is very broad and the legs are irregularly maculate in black.

TYPE LOCALITY.—Female holotype from Flaxman's Island, Alaska, July 18–August 6, 1909 (R. M. Anderson) and a female paratype from Colville River, Alaska, 1908, collected by the same individual.

***Pardosa wyuta*, new name**

Pardosa atra BANKS, 1894, Journal New York Entomological Society, II, p. 52.

Nec *Pardosa (Lycosa) atra* GIEBEL, 1869, Zeitschrift für die Gesamten Naturwissenschaften, XXXIV, p. 305.

RECORDS.—Salt Lake City, Utah, April to September, males and females (Gertsch). Zion National Park. July 5, 1932 (Gertsch). Montpelier, Idaho, August 17, 1931 (Gertsch).

***Pardosa giebelli* (Pavesi)**

Lycosa giebelli PAVESI, 1873, Atti della Società Italiana di Scienze Naturali, XVI, pp. 30 and 31.

Pardosa uncata EMERTON, 1894, Trans. Connecticut Academy Arts and Sciences, IX, p. 425 (part), Pl. III, figs. 8c, 8d, and 8f.

Pardosa untana GERTSCH, 1933, American Museum Novitates, No. 636, pp. 27 and 28.

DISTRIBUTION.—Switzerland. Austria. Siberia. Canada. Rocky Mountains: Wyoming, Idaho, Colorado and Utah.

RECORDS.—Cokeville, Wyoming, July 10, 1930 (Gertsch). Uinta Mountains, Utah, August (Gertsch). Kettle Rapids, Manitoba, July 15, 1917. Edmonton, Alberta, July.

***Pardosa modica* (Blackwall)**

Lycosa modica BLACKWALL, 1846, Annals and Magazine, Natural History, London, XVII, p. 33.

Pardosa brunnea EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 495, Pl. XLVIII, fig. 4.

RECORDS.—Minneapolis, Minnesota, May 10, 1932 (Gertsch). Pelham Bay, New York, March 20, 1921. Fish Lake, Sevier County, Utah, June 23, 1930 (Gertsch).

***Pardosa glacialis* (Thorell)**

Lycosa glacialis THORELL, 1872, Ofvers. K. Vet. Akad. Forh., XXIX, p. 159.

Lycosa aquilonaris L. KOCH, 1874, 'Zweite Deutsche Nordpolarfahrt,' II, p. 400, Pl. I, figs. 1 and 2.

Simon's synonymizing of *aquilonaris* with Thorell's species should be regarded with some suspicion, for subsequent work in that complex of forms has shown that most of them are distinct.

RECORD.—Manitoba.

***Pardosa groenlandica* (Thorell)**

Lycosa groenlandica THORELL, 1872, Ofvers. K. Vet. Akad. Forh., XXIX, p. 157.

Lycosa saccata BLACKWALL, 1846, Annals and Magazine Natural History, London, XVII, p. 34 (not *saccata* Linnaeus).

***Pardosa concinna* (Thorell)**

Lycosa concinna THORELL, 1877, Bulletin U. S. Geological Survey, III, p. 506.

Pardosa glacialis EMERTON, 1894, Trans. Connecticut Academy Arts and Sciences, IX, page 424 (part) Pl. IV, fig. 21.

Pardosa musicola EMERTON, 1911, idem, XVI, p. 401, Pl. V, figs. 2, 2a and 2b.

RECORDS.—Essex County, New York, July 28, 1917 (Notman). Kahtadin Summit, New Hampshire (Britcher). Seven Islands, Labrador, July 20, 1924 (Waugh). Nain, Labrador, July 3, 1922 (Waugh). Ward, Colorado, July 18, 1908 (Lutz). Sevier County, Utah, July 13, 1931 (Gertsch). Alaska, male (no further data).

The following four species are closely related in most respects, the principal differences being in the genitalia and in the relative leg lengths. They may be regarded as varietal forms of *Pardosa lapidicina* Emerton,

as was done by Chamberlin in 1908, but they are listed as distinct species in this paper. *Pardosa sabulosa* Banks has diverged sufficiently from the others to deserve specific rank. Cotypes of *Pardosa sierra*, *medialis* and *sabulosa*, all of Banks, in the collection of the Museum of Comparative Zoölogy are all identical, but the original descriptions and figures seem to indicate that the types, which are now destroyed, represented distinct species. *P. atromedia* Banks is a synonym of *sierra*.

***Pardosa lapidicina* Emerton**

Pardosa lapidicina EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 494, Pl. XLVIII, figs. 5 to 5a.

DISTRIBUTION.—Eastern United States.

***Pardosa mercurialis* Montgomery**

Pardosa mercurialis MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 270, Pl. XIX, figs. 20 and 21.

Pardosa texana BANKS, 1904, Journal New York Entomological Society, XII, p. 115, Pl. v, fig. 4.

Pardosa lapidicina CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 195, Pl. XIV, figs. 7 and 8 (part).

This name deserves to be maintained apart from *lapidicina*, *sensu strictu*, as either a species or a variety by virtue of the longer legs and slight differences in the genitalia. As here defined, it included most of the records of *lapidicina* that have been cited from Texas to California. An allied species, described as *atromedia* by Banks, has undoubtedly been confused with it to some extent in west coast records.

***Pardosa sabulosa* Banks**

Pardosa sabulosa BANKS, 1898, Proc. California Academy of Sciences, I, p. 273, Pl. XVI, fig. 28.

RECORDS.—Pedregales, Mexico, August, 1909 (Petrunkévitch). Jemez Springs, New Mexico, June 12–18, 1925 (Dietz).

***Pardosa sierra* Banks**

Pardosa sierra BANKS, 1898, Proc. California Academy of Sciences, (3) I, p. 274, Pl. XVI, fig. 20.

Pardosa medialis BANKS, 1898, idem, p. 273, Pl. XVI, fig. 29 (paratypes, not types).

Pardosa sabulosa BANKS, 1898, idem, p. 273, Pl. XVI, fig. 28 (paratypes, not types).

Pardosa atromedia BANKS, 1904, idem (3) III, p. 355, Pl. XXXIX, fig. 32.

I have seen specimens of this species from New Mexico, California, and Mexico. *Pardosa unquifera* Cambridge is closely related to and perhaps identical with *sierra*.

***Pardosa moesta* Banks**

Pardosa moesta BANKS, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 70, Pl. III, fig. 44.

RECORDS.—Minneapolis, Minnesota, May, 1930 (Gertsch. Itasca Park, Minnesota, May 29–30, 1932 (Gertsch). Yellowstone National Park, Wyoming, August, 1931 (W. E. Gertsch). Nounan, Bear Lake County, Idaho, August, 1932 (Gertsch).

***Pardosa uncatula* Cambridge**

Pardosa uncatula F. CAMBRIDGE, 1902, 'Biologia Centrali-Americana,' Araneidea, II, p. 320, Pl. XXI, figs. 1 and 2.

Pardosa paucilla MONTGOMERY, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 268, Pl. XIX, figs. 22 and 23.

DISTRIBUTION.—Mexico. Texas.

***Pardosa delicata*, new species**

FEMALE.—Total length, 4.50 mm. Carapace 2.40 mm. long, 1.85 mm. wide. Abdomen 2.25 mm. long, 1.50 mm. wide.

Cephalothorax evenly clothed with appressed black hairs, the area of the eyes with black spines and additional ones on the midline. Carapace dusky, the eye area black, medially with a very broad yellow band and the margins with a black seam. Mouth parts, sternum, coxae and legs dirty yellow, provided with black hairs, the legs with long black spines. Dorsum of the abdomen with a median hastate figure poorly indicated, otherwise yellow to brown, the venter light.

Eyes of the first row narrower than the second (21/34), the medians separated by scarcely a diameter, half as far from the smaller laterals. Clypeus twice as high as the diameter of an anterior lateral eye, armed with four submarginal black spines. Second row shorter than the third (34/42), the eyes scarcely a diameter apart, a little farther from the third row, the eyes of which are separated by nearly three diameters.

Tibia and patella I, 2.50 mm.

Tibia and patella IV, 3.00 mm.

Spines beneath the tibiae, 2–2–2.

Epigynum reddish brown, covered with white pubescence. Guide poorly developed anteriorly, consisting of a narrow neck, which enlarges caudally into a spatulate plate, longer than broad, through which the atrio-bursal openings on each side are clearly visible. In the characters of the epigynum and in color markings the species resembles *P. uncatula* Cambridge, *portoricensis* Banks, *floridana* Banks and other species, the principal difference being that the caudal portion of the guide is longer than it is broad.

MALE.—A representative of this sex lacks the legs and the abdomen, but seems to agree specifically with the female. The color markings of the carapace are much brighter and the light bands are invaded by dark spots. The palpus is all black, clothed with black hairs, the scopus a slender, sinuous spur resembling that of *Pardosa saxatilis* (Hentz), the spine at the base very small.

TYPE LOCALITY.—Female holotype, female paratype, and male allotype from La Zacualpa, Chiapas, Mexico, August, 1909 (Petrunkévitch).

***Pardosa bellona* Banks**

Pardosa bellona BANKS, 1898, Proc. California Academy of Sciences, (1) I, p. 275, Pl. XVI, fig. 21.

RECORDS.—Scottsdale, Arizona, January 13, 1903 (Britcher). Monroe Canyon, Sevier County, Utah, August 20, 1930 (Gertsch).

***Pardosa floridana* Banks**

Pardosa littoralis BANKS, 1896, Journal New York Entomological Society, IV, p. 192 (*littoralis* preoccupied).

Pardosa floridana BANKS, 1904, Proc. Acad. Nat. Sci. Philadelphia, p. 136, Pl. VII, fig. 1, Pl. VIII, fig. 15.

Pardosa banksi CHAMBERLIN, 1904, Canadian Entomologist, XXXVI, p. 175.

***Pardosa petrunkevitchi*, new species**

MALE.—Total length, 4.25 mm. Carapace 2.32 mm. long, 1.70 mm. wide. Abdomen 1.92 mm. long, 1.40 mm. wide.

Cephalothorax evenly covered with inconspicuous gray hairs. Area of the eyes shining black, the carapace dark brown, except for a median, longitudinal light band that begins behind the third eye row, is as wide as the interval between these eyes, and gradually narrows to the caudal margin. Pars thoracica with a weakly indicated, narrow, submarginal light band, the marginal dark band being quite as wide. Sternum, mouth parts and coxae yellow, sparsely clothed with black hairs. Legs yellow to light brown, the last two pairs with light yellowish hairs. First legs modified, the femur clothed with white hairs, the tibia slightly incrassate, somewhat darker brown in color, provided on all surfaces with a thick growth of long white hairs. Palpus dark brown. Dorsum of the abdomen with a median yellowish zone which encloses a gray, hastate marking; sides darker, the venter light.

First row of eyes narrower than the second (17/24), slightly procurved, the medians separated by two-thirds of a diameter, half as far from the smaller laterals. Clypeus one and one-half times as wide as the diameter of an anterior lateral eye. Second row of eyes separated by a diameter, scarcely one and one-half times as far from the smaller eyes of the third row, which are three diameters apart.

Tibia and patella I, 2.00 mm.

Tibia and patella IV, 2.40 mm.

Spines under the tibiae, 2-2-2, the prolateral row of the first pair lacking the distal one and the others reduced in size.

Palpus with a covering of black hairs. The bulbal apophyses resemble those of *longivulva* Cambridge and to a lesser extent *falcifera* Cambridge. The scopus is a heavy apophysis, provided with the customary stout curved spur at the base, the remainder a long heavy tube that is straight throughout its length, rounded at the end and directed in an anterolateral direction. The embolus is a stout black spine that curves beneath the superior scopal element.

TYPE LOCALITY.—Male holotype from Tonalá, Chiapas, Mexico, collected in August, 1909, by Prof. A. Petrunkevitch.

It is not unusual to have members of this genus in which the pubescence on the legs is conspicuous, especially in some of the boreal species. No other American *Pardosa* with which I am familiar has the first legs so strikingly modified as this new form. The long white hair on the tibia is not matched in any of the numerous forms that are otherwise closely related, e.g. *Pardosa prolifica*, *longivulva*, *bellona*, etc.

***Pardosa prolifica* F. Cambridge**

Pardosa prolifica F. CAMBRIDGE, 1902, 'Biologica Centrali-Americana,' Araneidea, II, p. 317, Pl. xxx, figs. 19 and 20.

RECORDS.—Scottsdale, Arizona, January 17, 1903 (Britcher).

***Pardosa falcifera* F. Cambridge**

Pardosa falcifera F. CAMBRIDGE, 1902, 'Biologica Centrali-Americana,' Araneidea, II, p. 318, Pl. xxx, figs. 23 and 24.

Pardosa orthodox CHAMBERLIN, 1924, Proc. California Academy Sciences, (4) XII, p. 671, Fig. 114.

DISTRIBUTION.—Lower California. Mexico. Southwestern United States.

RECORDS.—Tucson, Arizona, July 3–5, 1916. Scottsdale, Arizona, January 17, 1903 (Britcher). Zion National Park, Utah, July 5, 1931 (Gertsch). Hurricane, Utah, July 7, 1931 (Gertsch and Johnson). Salt Lake City, Utah, August, 1931 (Gertsch).

***Pardosa saxatilis* (Hentz)**

Lycosa saxatilis HENTZ, 1844, Journal Boston Soc. Natural History, IV, p. 392, Pl. xviii, figs. 9 and 10.

Pardosa atlantica EMERTON, 1913, Bulletin American Museum Natural History, XXXII, p. 258, Pl. XLVIII, fig. 7.

RECORD.—Marysville Canyon, Sevier County, Utah, May 26, 1930, female (Gertsch).

***Pardosa mulaiki*, new species**

MALE.—Total length, 3.75 mm. Carapace 2.00 mm. long, 1.45 mm. wide. Abdomen 1.85 mm. long, 1.10 mm. wide.

Cephalothorax with short, black, inconspicuous hairs, the margins with white hairs, the eye region and clypeus with black spines. Carapace black, medially with a faintly marked longitudinal lighter streak that, anteriorly, scarcely passes the median suture, the margins with an inconspicuous light submarginal band that is obliterated before it reaches the head portion. Sternum black, the endites and labium dusky, the

coxae yellowish below. Legs dusky yellow, the basal leg joints and the femora maculate above in black. Palpus all black except the patella, which is light and apparently once clothed with white hairs as in *saxatilis* Hentz. Dorsum of abdomen nearly black, the venter somewhat paler.

Eyes of the first row narrower than the second (16/23), slightly procurved, the medians a diameter apart, half as far from the somewhat smaller laterals. Clypeus twice as high as the diameter of an anterior lateral eye. Second row of eyes narrower than the third (23/40), about a diameter apart, one and one-third diameters from the smaller eyes of the third row, which are more than three diameters apart.

Tibia and patella I, 1.75 mm.

Tibia and patella IV, 2.15 mm.

Spines beneath the tibiae, 2-2-2.

The palpus is clothed with black hairs and a few stout spines. The affinities of the species are clearly with *saxatilis*, *milvina*, and related species. The scopus furnishes the distinguishing characters. It is considerably shorter than in the first-named species. It is heavy basally and provided at that point with a sharp spine, the principal element directed anterolaterad, gently rounded and ending in a sharp point. In *milvina* the principal part is directed anteriorly and is broadly rounded or elbowed near the end, the distal part pointing laterad. The embolus is a fine tube that terminates near the distal end of the scopus, near which point is a black spur on the bulb.

TYPE LOCALITY.—Male holotype from Edinburgh, Texas, collected by Mr. Stanley Mulaik.

Pardosa sternalis (Thorell)

Lycosa sternalis THORELL, 1877, Bulletin U. S. Geological Survey, III, p. 504.

Lysosa ramulosa MCCOOK, 1893, 'American Spiders,' III, Pl. xxx, figs. 5 and 6. (No verbal description).

Pardosa futilis BANKS, 1898, Proc. California Academy Sciences, (3), p. 274, Pl. xvi, fig. 23 (male cotype, not type).

Pardosa peninsulana BANKS, 1898, idem, p. 275, Pl. xvi, fig. 22.

Pardosa vancouveri EMERTON, 1917, Canadian Entomologist, XLIX, p. 269, Fig. 20.

This is undoubtedly the commonest western *Pardosa* and is found up to 10,000 feet or more in the Rocky Mountains. Specimens named *Lycosa ramulosa* by McCook in the Academy of Natural Sciences of Philadelphia are this species and, though they are not marked as types, probably represent his original material.

Pardosa distincta (Blackwall)

Lycosa distincta BLACKWALL, 1846, Annals and Magazine Natural History, London, XVII, p. 32.

Pardosa pallida EMERTON, 1885, Trans. Connecticut Academy Arts and Sciences, VI, p. 496, Pl. XLIX, fig. 3. (Preoccupied name.)

Pardosa emertoni CHAMBERLIN, 1904, Canadian Entomologist, XXXVI, p. 175.

Pardosa utahensis CHAMBERLIN, 1919, Annals Entomological Society of America, XII, p. 258, Pl. XIX, fig. 11.

RECORDS.—Minneapolis, Minnesota, June, 1931 (Gertsch). Boulder, Colorado, July 7, 1908 (Lutz). Cascade, Colorado, July 16, 1914 (Fisk). Estes Park, Colorado, July 5, 1913 (Lutz). Sevier County, Utah, July 13, 1930 (Gertsch). Beaver Creek, Utah, August 5, 1931 (Gertsch). Crow Creek, Idaho, August 4 (Gertsch). St. Charles Canyon, Idaho, July 8, 1931 (Gertsch). Yellowstone National Park, Wyoming.

Pardosa hyperborea (Thorell)

Lycosa hyperborea THORELL, 1869, 'Remarks on Synonyms of European Spiders,' p. 293.

Pardosa luteola EMERTON, 1894, Trans. Connecticut Academy Arts and Sciences, IX, p. 427, Pl. III, fig. 7.

Pardosa distincta CHAMBERLIN, 1908, Proc. Acad. Nat. Sci. Philadelphia, p. 192, Pl. xv, figs. 8 and 9 (not *distincta* Blackwall).

RECORDS.—Seven Islands, Quebec, July 6, 1929 (Waugh). Kettle Rapids, Manitoba, July 15, 1917. Maine (Britcher).

Pardosa yavapa Chamberlin

Pardosa yavapa CHAMBERLIN, 1925, Bulletin Museum of Comparative Zoölogy, LXVIII, pp. 231-232.

Pardosa sanuiana CHAMBERLIN, 1928, Canadian Entomologist, LX, pp. 94-95.

RECORDS.—Meeker, Colorado, July 29, 1909 (Lutz). Estes Park, Colorado, August 8, 1913 (Lutz). Weber Canyon, Utah, May 16, 1931 (Rowe). Henry Mountains, Utah. Richfield, Utah, July, 1930 (Gertsch). Fish Lake, Weber County, July, 1930 (Gertsch). Mud Springs, Pine Canyon, Santa Catalina Mountains, Arizona, July 17, 1916 (Lutz). Flagstaff, Arizona (Peterson).

Pardosa montgomeryi, new species

MALE.—Total length, 4.25 mm. Carapace 2.07 mm. long, 1.50 mm. wide. Abdomen 2.10 mm. long, 1.12 mm. wide.

Cephalothorax clothed with a very sparse covering of black hairs. Carapace with a median longitudinal light band that gradually broadens until at its anterior end it is nearly as broad as the third eye row, the eye quadrangle black. Sides with broad submarginal light bands, the darker intervals or stripes not much wider than the median or marginal bands. Sternum, mouth parts, and endites light, concolorous with the legs, which are unmarked except for the dark femora. Abdomen dark on the sides, medially with a poorly marked lighter hastate maculation, the venter light.

First row of eyes narrower than the second (17/28), slightly procurved, the medians separated by a diameter, less than half as far from the equal laterals. Cly-

peus about three times as high as the diameter of an anterior median eye. Second row of eyes narrower than the third (27/32), a diameter apart, half again as far from the smaller eyes of the third row, which are separated by three diameters.

Tibia and patella I, 1.82 mm.

Tibia and patella IV, 2.50 mm.

Spines under the tibiae, 2-2-2.

Palpus black, clothed with black hairs. The species is closely related to *P. yavapa* Chamberlin and *P. distincta* (Blackwall), the principal difference being in the median apophysis of the bulb. This process is moderately stout, strongly bent near the base as in no other described species, elongate, the truncate distal end resting at the retro-lateral cymbial margin. A short spine is present near the base of the apophysis as in *P. sternalis* (Thorell). The embolus is a fine tube, hidden by the scopal element. In *P. yavapa* the scopus is a long process, evenly rounded, and usually acutely ended, never bent at the base.

TYPE LOCALITY.—Male holotype from Edinburgh, Texas, collected by Mr. Stanley Mulaik.

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A NEW SPECIES OF *AMBLYCASTOR* FROM THE *PLATYBELODON* BEDS, TUNG GUR FORMATION, OF MONGOLIA¹

By R. A. STIRTON²

The appearance of *Amblycastor* in the *Platybelodon* beds of Mongolia offers another genus which may be used in correlating the faunas of the Eastern and Western Hemispheres. The genotype was described by Matthew³ from the Lower Snake Creek beds of western Nebraska. There are some isolated teeth from the Pawnee Creek beds of Colorado and possibly one specimen from a Miocene fauna near Fleming, Texas.

A dental terminology for beaver teeth has been worked out for a paper now in press, "A Review of the Tertiary Beavers." Some of

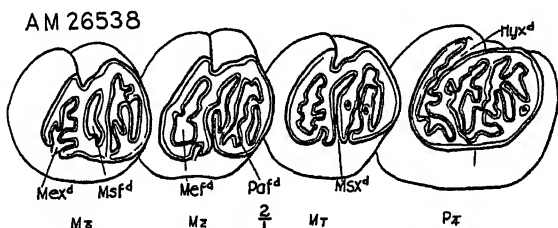


Fig. 1. *Amblycastor tungurensis*, new species, A. M. 26538. Left lower cheek teeth. Twice natural size.

Hxnd = hypoflexid; *mfd* = metafossettoid; *mexd* = metaflexid; *mfd* = mesafossettoid; *mexd* = mesoflexid; *pafd* = parafossettoid.

these names have been used in this description of a new species from Mongolia. The occlusal inflections, lateral grooves and isolated lakes have been called flexi or flexids, striae or striids and fossettes or fossettids. These names have been prefixed in accordance with their proximity to the main cusps on the tooth.

I wish to thank Dr. Walter Granger and Père Teilhard de Chardin⁴ for the privilege of studying and describing the Mongolian material. The drawings were made by Owen J. Poe.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 122.

²Museum of Palaeontology, University of California.

³Matthew, W. D. 1918. Bull. Amer. Mus. Nat. Hist., XXVIII, pp. 197-199, figs. 7-9.

⁴The specimens were originally allotted to Père Teilhard who in turn gave them to me for description.

GENERIC DIAGNOSIS.—Incisors with convex anterior faces which are grooved longitudinally as in *Trogontherium* and *Castoroides*; lower molars with a mesastriid and a hypostrid, neither extending to the base of the tooth; cheek teeth relatively low-crowned; diastema of lower jaw normal, not short; large crescentic parafoissette on anterior half of P₄; P₄ not as elongate as in other castoroids.

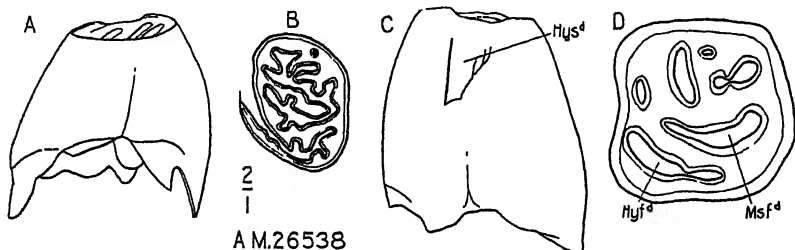


Fig. 2. *Amblycastor tungurensis*, new species, A. M. 26538. Left P₄; A, lingual view; B, occlusal view; C, labial view; D, cross-section drawn from open base of tooth. Twice natural size.

Hylf = hypofossettid; *hysd* = hypostrid; *msfd* = mesafossettid.

Amblycastor tungurensis, new species

TYPE.¹—A. M. 26538. Left lower jaw with P₄-M₃, a fragment of a right P₄, a right M₁-M₂, a right M¹⁻², a left M², seven skull fragments and part of a right lower jaw.

PARATYPES.—A. M. 26539. A left P₄, a left M₂, fragments of two femora, a tibia, a calcaneum and an ulna.

LOCALITY.—Twenty-five miles northeast of Gur Tung Khara Usu, Eastern Gobi, Mongolia; *Platybelodon* beds; Upper Miocene.

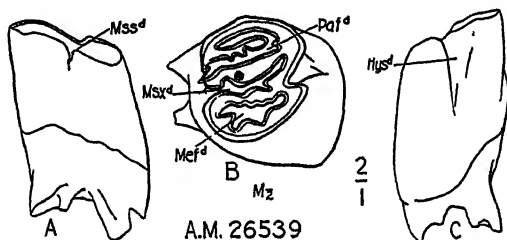


Fig. 3. *Amblycastor tungurensis*, new species, A. M. 26539. Right M₂; A, lingual view; B, occlusal view; C, labial view. Twice natural size.

Hysd = hypostrid; *mef* = metafossettid; *msd* = mesastriid; *mzrd* = mesofezid; *paf* = parafoissettid.

SPECIFIC DIAGNOSIS AND DESCRIPTION.—P₄-plications of fossettids probably more complicated than in *A. fluminis* Matthew; no mesastriid; two fossettids open into the hypostrid, the anterior of which is a small fossettid while the posterior is long (there is no trace of the anterior fossettid in *A. fluminis*); the metafossettid is con-

¹The association of the isolated teeth, right jaw and skull fragments with the left lower jaw is not certain. Most of the teeth were found at one site while the limb bones (paratype) were found at another.

nected with the hypoflexid; the mesafossettid in *A. fluminis* is more crescentic and larger than in *A. tungurensis*; the parafoesettid of *A. fluminis* is represented in *A. tungurensis* by two isolated fossettids, also a tiny anterior fossettid.

LOWER MOLARS.—With three anterior and two posterior roots; enamel plications more complicated than in *A. fluminis*; hypostriid very short; one posterior and two anterior fossettids; sometimes the two anterior fossettids are connected at one end.

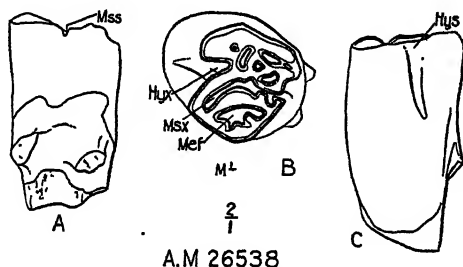


Fig. 4. *Amblycastor tungurensis*, new species, A. M. 26538. Left M¹; A, labial view; B, occlusal view, C, lingual view. Twice natural size.

Hys = hypostria; *hys* = hypoflexus; *msf* = metafossette; *mss* = mesostria; *msx* = mesaflexus.

UPPER PREMOLAR (P⁴).—Four anterior fossettes instead of one as in *A. fluminis*; with large crescentic metafossette similar to *A. fluminis*; although part of the tooth is broken away, four or five posterior fossettes are still present; P⁴ in the Mongolia species is more complicated than in *A. fluminis*.

UPPER MOLARS.—Usually with five or six anterior fossettes, one long crescentic mesaflexus or mesafossette and a prominent metafossette.

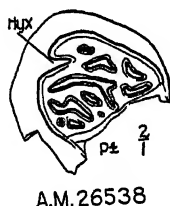


Fig. 5



Fig. 6

Fig. 5. *Amblycastor tungurensis*, new species, A. M. 26538. Right P⁴. Twice natural size.

Hys = hypoflexus.

Fig. 6. *Amblycastor tungurensis*, new species, A. M. 26538. Cross-section of incisor. Twice natural size.

INCISOR.—With convex enamel face. The surface is grooved longitudinally as in *Castoroides* and *Trogontherium*.

LIMB BONES.—Femur flattened as in *Castor*, but its third trochanter is more proximal than in the living beaver. It differs from *Erethizon* which has a femur with a round shaft and no prominent third trochanter. Tibia curved anteriorly at its

distal end as in *Castor*, and the posterior border at the distal end of the shaft shows a rugose area indicating an appressed fibula. In *Erethizon* the tibia does not curve anteriorly nor are the tibia and fibula appressed at their distal ends as in *Castor*. Tuber calcis of the calcaneum shorter and calcaneal facet slightly different from *Castor*; the fragment in this collection is quite unlike that of *Erethizon*. Greater sigmoid facet of ulna not as symmetrical as in *Erethizon*, shaped like that of *Castor* but wider. Radial facet not as distinct as in *Erethizon*, and although very like *Castor*, it extends farther posteriorly (as a process) than in that genus. Shaft flattened with wide sulcus on medial side also with distinct sulcus opposite anconeal process. This bone is distinctly different from *Erethizon* which has a round shaft.

REMARKS.—The beavers of Pliocene age which have been found in the *Hipparion* faunas of Eastern Asia are: (1) *Castor andersoni* (Schlosser) and *Dipoides* cf. *major* Schlosser, from Olan Corea and Ertemte in Mongolia; (2) *Castor broilii* (Teilhard and Young), *Castor zdanskyi* Young, and *Dipoides major* Schlosser from northwest Shansi in North China. *Amblycastor tungurensis* is easily distinguished from these forms by its longitudinally grooved incisor and complicated cheek-tooth pattern.

SUMMARY.—(1) *Amblycastor tungurensis*, the new species, is closely related to although specifically distinct from *A. fluminis* Matthew from the Lower Snake Creek (Upper Miocene) fauna in North America. (2) The fragmentary limb bones indicate that *Amblycastor* is a beaver and not an hystricomorph. (3) The Mongolian species, apparently, possessed a larger head though shorter limbs than *Castor*, and the limb bones are flattened as in the living beaver.

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SOME INSTANCES OF INCRUSTATIONS SELECTIVE UPON CRYSTAL FORMS

BY CLIFFORD FRONDEL

STILBITE INCRUSTING APOPHYLLITE

An incrustation localized to a particular form of the incrustated crystal is shown by a specimen of apophyllite from Bergen Hill, New Jersey, contained in the collection of The American Museum of Natural History (Cat. No. 12690). The specimen consists of a slab of altered diabase about 14×17 cm. in size with its surface incrustated by datolite, calcite, apophyllite and stilbite, the sequence of deposition being in the order given. The apophyllite crystals are formed of (100), (111) and (001), the larger crystals being tabular parallel (001), and comprise about 20 individuals, the largest measuring $\frac{1}{4}$ cm. across the prism. The (001) form of the crystals is incrustated by stilbite which is lacking or forms only a few isolated crystals on the faces of (100) and (111). Apophyllite crystals attached to the matrix by their sides show the incrustation at both ends. The stilbite, which incrusts both the datolite and the apophyllite, being selective with regard to forms only on the latter,¹ is also peculiar in that when incrusting datolite the crystals are large (4–12 mm.) and scattered and are attached randomly. On the base of the apophyllite, however, the stilbite forms a dense crust of small (1–2 mm.) crystals which are oriented with their vertical axes perpendicular, or approximately so, to the apophyllite surface. The few stilbite crystals noted upon (100) and (111) are also relatively large and of random orientation to the incrustated surface.

Other apophyllite specimens from Bergen Hill and other localities were observed in the collection in which the crystals were incrustated by stilbite, but these did not show selectivity upon the forms. Laumontite, analcite, natrolite, stilpnomelane, calcite and pyrite were also observed indiscriminately incrusting the forms of apophyllite. A specimen showing stilpnomelane selectively incrusting the forms of datolite crystals, from Snake Hill, N. J., is contained in the collection and is to be described.

¹An incrustation of stilbite selective upon the forms of a datolite crystal from Great Notch, N. J., as been described by C. W. Cook and E. H. Kraus (1915, Amer. Jour. Sci., Ser. 4, XXXIX, p. 643)

Structurally apophyllite can be compared to the zeolites, with which it is sometimes classed, and in which, as typified by analcite,¹ the relatively open but strongly bonded anionic framework permits the passage of cations in base exchange and of water in dehydration or hydration through the meshes of the structure without destruction of the crystal. The structure of natrolite is such as to allow the movement of water in dehydration or sodium ions in base exchange through channels along (001)², and, similarly, the speed of diffusion of water into dehydrated heulandite has been experimentally determined to be greater for (001) than for other forms.³ The natural alteration of apophyllite to *albin* in which Ca is substituted into the structure is observed to start on the basal plane and to proceed thence into the interior, with the prism and other forms not being altered directly.⁴ The alteration appears as a white opaque layer extending into the crystal from the surface of (001). Basal plane alterations in various stages of development were seen on apophyllite specimens from Bergen Hill, West Paterson and Great Notch, N. J., Nova Scotia, and other localities. The nature of the chemical change in these instances is unknown. An incipient, paper-thin, alteration of this kind is developed on the specimen described underneath the stilbite incrustation.

The vertical direction in apophyllite is also the one of most rapid attack by solution.⁵ The difference in rate of solution relative to other directions is quite pronounced. Cornu⁶ notes that (111) is between (100) and (001) in resistance to solvents. A selective etching of (001) is not infrequently seen on natural crystals.

The basal plane of apophyllite when examined under the microscope shows a markedly composite structure. This is true to a much lesser extent of (111) while (100) is generally smooth and lustrous, although strongly striated.

The tendency for localization of the stilbite deposition to the basal plane of the apophyllite is believed to reflect the strong adsorption of substance upon that plane from a solution capable of depositing stilbite and in which solution the datolite, calcite and the (100) and (111) forms of apophyllite were weakly or non-adsorbing. The effect of the adsorption is to facilitate the formation of crystal nuclei upon the adsorbing surface⁷ and, with the crystallization of the stilbite solution, the (001)

¹Taylor, W. H. 1930. Zerts. Kryst., LXXIV, p. 1.

²Pauling, L. 1930. Proc. Nat. Acad. Sci., XVI, p. 454.

³Gaubert, F., 1929. Bull. Soc. Min. France, LII, p. 162.

⁴Cornu, F. 1907. Centralblatt Min., p. 210.

⁵Honess, A. F. 1927. 'The Etch Figures on Crystals,' New York, pp. 47-50, 78-82.

⁶Cornu, F., op. cit., p. 211.

⁷Freundlich, H. 1920. Alexander's 'Colloid Chemistry,' New York, I, p. 558.

surfaces will tend to become incrustated in preference to the adjacent (100) and (111) surfaces. The thin white altered layer of apophyllite noted as forming the surface of (001) is probably in genetic relation to the stilbite deposition and may then represent a diffusion of the adsorbate into the crystal. The densely packed nature of the incrustation upon (001) and the small size of the crystals point to closely spaced centers of crystallization, and the tendency of the stilbite crystals to orient themselves perpendicular to (001) suggests an orientation of the adsorbate at the interface.

Efforts by the writer to form selective crystallizations of various salts upon (001) by using large well-formed apophyllite crystals as nuclei in the crystallizing solution have not yet proven successful. What amounts to a selective crystallization of sodium nitrate upon the forms of calcite has been obtained experimentally by Settele.¹ Sodium nitrate is strongly adsorbed by calcite and readily forms parallel growths upon it, the two substances being isomorphous. By using a polished sphere of calcite cut from a single crystal, Settele obtained six isolated groups of oriented sodium nitrate rhombohedrons upon its surface, each group of crystals being centered above the poles of $(10\bar{1}1)$, that is, at $(10\bar{1}1)$, $(\bar{1}101)$, $(0\bar{1}11)$ $01\bar{1}\bar{1}$, $(\bar{1}0\bar{1}\bar{1})$ and $(\bar{1}\bar{1}0\bar{1})$, the surface of the sphere representing the spherical projection. This method shows directly that under the conditions of the experiment calcite crystals composed of $(10\bar{1}1)$ and any other form or forms will be selectively incrustated by sodium nitrate upon $(10\bar{1}1)$. Conversely, calcite crystals grown from solutions containing sodium nitrate will tend to assume the $(10\bar{1}1)$ habit. This sphere method should be applicable in determining the influence of adsorption on the crystal habit of mineral species whose chemical nature is such as to prevent an experimental investigation by direct crystallization from a solution containing additives.

HEMATITE FILMING CALCITE

A suite of 19 specimens from West Paterson, New Jersey (Cat. Nos. 19657: 1-13; 19697: 1-4; 12712, 17549), presents drusy surfaces of small quartz crystals implanted on altered diabase, associated with calcite, babingtonite and zeolites. The quartz crystals are peculiar in that their forms are selectively filmed by red hematite of colloidal origin, the film generally being present on $(10\bar{1}1)$ and $(10\bar{1}0)$ and absent from $(01\bar{1}1)$ ², and the calcite crystals associated with them are likewise selectively filmed by the hematite. The calcite crystals are white and trans-

¹Settele, M. 1930. *Neues Jahrb. Min., Abt. A., Beil.- Bd, LXI*, p. 227, fig 37

²Fron del, C. 1934. *Amer Min.*, XIX, p.—.

lucent, running between 2 and 6 mm. in vertical length, and about a hundred distinct crystals are developed on the specimens.

The habit of the crystals is highly complex and is characterized by a strongly marked zone of negative rhombohedrons, usually limited by the basal pinacoid, and three well-marked zones of scalenohedrons. Their crystallography has been studied by Whitlock¹ and the reader is referred to his paper for a detailed description and figures of the crystals. The habit of the crystals varies in minor respects on different specimens, and single crystals do not present all the observed forms, but the suite as a whole is closely integrated by the zonal relations of its forms and represents, in its entirety, a generation of calcite (Type V of Whitlock) distinct from other generations of calcite that can be distinguished in the zeolite occurrences of the New Jersey diabase region. The forms present on the most common habit and which may be said to represent the generalized habit of the suite (Combination 15, Fig. 20, of Whitlock) are tabulated in Table 1, together with minor variants of this habit (Combination 16, Fig. 21, and Combination 17, Fig. 22, of Whitlock) on which additional new or rare forms are developed. The forms (15.8.23.10) and (15.8.23.13) may be vicinal to (8.4. $\overline{12}$.5) and 8.4. $\overline{12}$.7). Crystals which approach Combination 17 in habit are relatively few.

The form (02 $\overline{2}$ 1) is present on all of the crystals and in all of the combinations was observed to be filmed by red hematite in preference to the other forms. The film is present on all but a few of the hundred or so crystals present on the specimens. The film is rather less intense than on the associated quartz crystals, where it has a deep red or brick-red color, and in many instances the faces of (02 $\overline{2}$ 1) appear only as faint rose-colored areas. It is closely adherent to the surface and cannot be removed without injury to the calcite; the film on the quartz can be rubbed off by using pressure. The edges of the filmed faces are generally strongly marked by a deep red line of hematite, and this edge deposition seems to represent the initial stage of formation of the film.

The origin of the film is ascribed to the selective adsorption of colloidal hydrous ferric oxide from a sol which bathed the crystals in the druse at some time after the completion of their growth. Four other instances of colloidal hydrous ferric oxide selectively filming calcite have been mentioned elsewhere.²

¹Whitlock, H. P. 1927. Bull. Amer. Mus. Nat. Hist., LVI, pp. 365-370.

²Frondel, C., op. cit.

TABLE 1

Forms	Combination 15, Figure 20	Combination 16, Figure 21	Combination 17, Figure 22
(0001)	*	*	
(4483)	*		
(1011)	*	*	*
(4041)		*	*
(0445)	*	*	*
(0887)	*	*	*
(0443)	*	*	*
(0332)	*		
(0.11.11.6)	*		
(0221)	*	*	*
(0441)	*		
(0551)			*
(0.11.11.1)	*	*	*
(1674)		*	
(2.10.12.7)	*	*	
(2.8.10.3)	*		
(4.10.14.3)		*	
(2461)	*	*	*
(15.8.23.13)	*		
(6.4.10.5)	*	*	
(8.4.12.7)		*	
(8.4.12.5)		*	*
(5494)	*		
(4.60.64.49)	*		
(14.2.16.3)			*
(5.10.15.8)			*
(5.10.15.7)			*
(1896)	*		
(2794)	*	*	
(15.8.23.10)	*		

MARCASITE INCRUSTING CALCITE

J. E. Pogue¹ has described a marcasite incrustated calcite from Joplin, Missouri, which shows a peculiar arrangement of the incrustation with respect to the calcite forms. The crystal is a large honey-yellow individual showing the scalenohedron (2131) modified by faces of (5164), (6178) and (1011). The marcasite is present only on (2131), and the incrustation on the faces of this form extends only to within 4 mm. of the edges between it and (5164). Here the boundary of the incrustation forms a sharp even line running parallel to the edge to within a few mm.

¹Pogue, J. E. 1910. *Smithson. Misc. Coll.*, LII (Quart. Issue, V, p. 465.

of the acute edges of $(21\bar{3}1)$ where it bends down sharply in a direction roughly parallel to the cleavage and intersects the edges at a sharp angle.

Study of a suite of crystals from Joplin similar to the crystal described by Pogue shows that the features of his specimen are not due to a selective action exerted by the calcite forms over the marcasite deposition, as would appear, but to a complete incrustation of the surface of the crystal followed by a partial overgrowth of calcite which hid from view part of the incrustation. These specimens are large modified scalenohedrons with an inner phantom completely incrustated by marcasite visible under the surface of the terminating forms. The overgrowth took place only on the terminating forms of the early crystal so that the original surface of $(21\bar{3}1)$ with its marcasite incrustation forms part of the present surface of the crystal. In view of this, the boundary of the marcasite incrustation on Pogue's specimen traces the edges of incrustated forms earlier present on the crystal and later overgrown. The reëntrant angles along the acute edges of $(21\bar{3}1)$ evidently mark the edges of small faces of a negative rhombohedron or scalenohedron that was suppressed during the overgrowth. The crystal nuclei of the marcasite were carried against the calcite by a current, as is evidenced by a tendency for concentration of the marcasite on one side of the crystals; this was also noted by Pogue.

This same feature is illustrated by a calcite specimen from Bergen Hill, New Jersey (Cat. No. 6975), which shows stubby crystals composed of $(10\bar{1}1)$ and $(21\bar{3}1)$ with their entire surface colored brick-red by earthy hematite. The faces of $(10\bar{1}1)$ were later overgrown by white opaque calcite which nearly completed $(21\bar{3}1)$ and formed a white crystal with a central zone of red calcite.

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THE NORTH AMERICAN LONCHOPTERIDAE (DIPTERA)

By C. H. CURRAN

The family Lonchopteridae includes only the genus *Lonchoptera* Meigen and is represented in the Palaearctic region by eight species according to Duda's¹ revision of the family, although the Palaearctic catalogue includes eighteen names of species, and some of these may represent distinct forms. In 1906, De Meijere² published an excellent revision of the family as represented in the same region and gave detailed descriptions and synonymy, but dealt with only seven species.

In North America several names have been applied to our common and very variable species, and it has long been the belief that only the one species occurred on this continent.

The four species in the collections before me, comprising material from the Canadian National Collection and the United States National Museum in addition to specimens in the American Museum, are all described as new. In the two species where males are known the genitalia differ from the figures of the European species and the other species do not agree with descriptions.

In the case of our commonest species, to which I have applied the name *dubia*, it is almost certain that no males exist and that the species reproduces parthenogenetically, and it is possible that the same is true of *unisetata*, although this species is known from only four specimens. In the other two species the two sexes appear to occur in about equal numbers. In 1918, Dr. J. M. Aldrich published an article³ in which he records 2652 females and no males. Another lot of about 2000 specimens was examined by Dr. Aldrich at Moscow, Idaho, but I do not know whether these results were published. I have seen none of the specimens from those two lots, but it seems probable that the records refer to *dubia*, although there may also have been specimens of *unisetata* in the collections. Males of *furcata* Fallén and *lutea* Panzer are quite well known and the genitalia have been illustrated by De Meijere and, even though the females of *dubia* could not be separated from *furcata* on structural characters, the absence of males would seem to indicate that it is a distinct

¹Konowia, VI, pp 89-99.

²Tijd v ent., XLIX, pp 44-98 (2 plates).

³Psyche, XXV, p. 33.

species. However, there are differences, and these are noted in the observations following the description.

The wing venation in the two sexes is quite different. In the males the sixth vein runs to the margin of the wing but in the females it unites with the fifth vein, forming a large, closed cell. The position of the end of the sixth vein in relation to the furcation of the fourth has been used as a diagnostic character for the separation of Palearctic species but has no significance in a study of Nearctic forms. The best characters are apparently those found on the legs, where the chaetotaxy is distinctive, the color of the vertical bristles and occipital cilia (postorbital bristles), and the shape and chaetotaxy of the wings. Color appears to be of little value although some species are said to show no variation. In the males the genitalia are distinctive but the ovipositor apparently offers no characters.

I am indebted to Dr. J. M. Aldrich for furnishing specimens and to Dr. J. McDunnough for the material from the Canadian National Collection.

TABLE OF SPECIES

- 1.—Bristles of the vertex and the orbital cilia wholly yellowish. 4.
At least several of the upper orbital cilia black 2.
- 2.—Bristles of the vertex black 3.
Bristles of the vertex yellowish; about half the orbital cilia black 4.
- 3.—Wings very sharply pointed, very slightly concave posteriorly toward the apex,
or at any rate not gently convex. *uniseta*, n. sp.
Wings broader and much less sharply pointed, gently convex before the apex.
occidentalis, n. sp.
- 4.—Anal vein widely removed from the border of the wing; base of fifth vein with
four or five long bristles. *borealis*, n. sp.
Anal vein fused with the posterior border of the wing; base of fifth vein with
numerous setulae *dubia*, n. sp.

Lonchoptera uniseta, new species

Figure 1

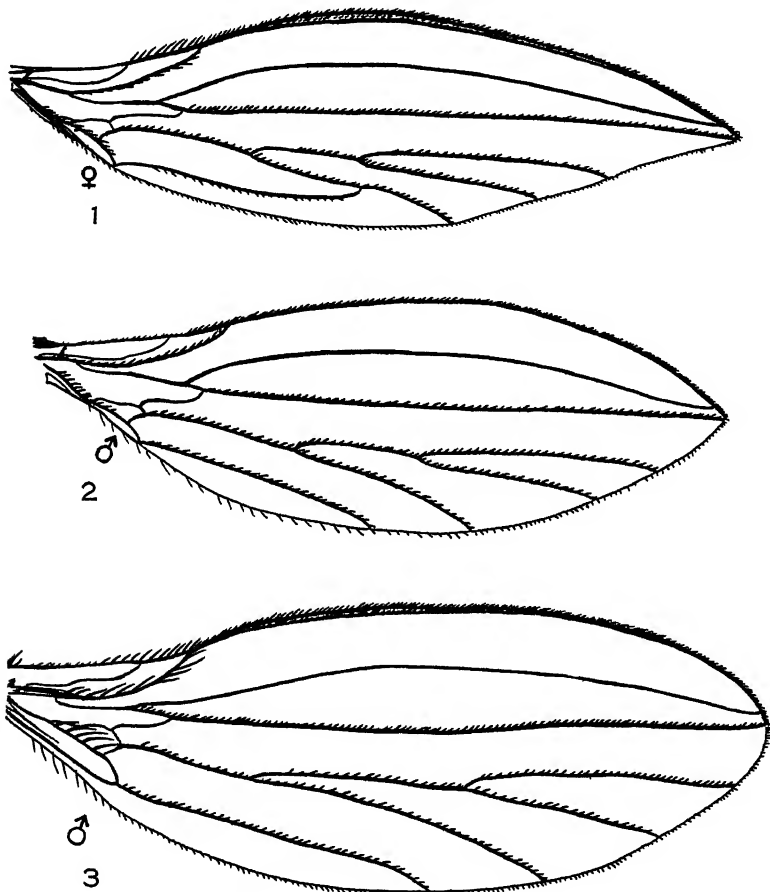
Blackish, the face, legs and halteres yellowish. Length, 2.5 mm.

FEMALE.—Upper occipital cilia and frontal bristles wholly black; front white pollinose except on the ocellar triangle; lower occipital cilia and hairs yellow; face and cheeks yellow, the oral margin with four or five black bristles on either side. Labellae pale brownish; palpi yellow. Antennae brown, the basal segment more or less reddish.

Thorax blackish, rather thickly cinereous pollinose; scutellum reddish brown in ground color.

Legs yellowish, the anterior pair brown or brownish red, the knees paler, the coxae yellow; apical segment of the posterior four tarsi black or brown. Anterior

tibiae with only two bristles, an anterodorsal one beyond the basal third and a pre-apical posterior bristle; middle tibiae with two anterodorsal bristles and a posterodorsal situated near the basal third; posterior tibiae with two anterodorsal bristles, two anteroventrals, and a single posterodorsal, the latter situated near the middle.



Figs. 1-3. Wings of *Lonchoptera*.

1, *L. unisetata*, new species; 2, *L. occidentalis*, new species; 3, *L. borealis*, new species.

Wings cinereous hyaline; sixth vein ending behind the fork of the fourth vein; anal vein confluent with the posterior border of the wing. Halteres yellow.

Abdomen blackish thinly grayish-brown pollinose, the venter with paler pollen.

Types.—Holotype, female, Colorado (Wheeler Collection). Paratypes: two females, Thunder River, Quebec, June 11, 1929 (W. J. Brown); female, Kaslo, British Columbia, June 6 (H. G. Dyar). Paratypes in Canadian National Collection and United States National Museum.

Only this and the following species have a single dorsal bristle on the front tibiae. The two species are easily separated by the shape of the wings, but are almost identical in other respects.

***Lonchoptera occidentalis*, new species**

Figure 2

Agrees with *uniseta* in practically every respect, but the wings are much less pointed and wider, and the anterior legs are paler in color. The two species are so similar in color and chaetotaxy that a detailed description is unnecessary.

The male has the posterior forceps or cerci elongate, forming an oval appendage, the apex emarginate, the apex of each lobe rather evenly rounded but slightly longer toward the inner side, the appendages covered on their posterior side and outer and apical margins with short, fine black hair.

Types.—Holotype, male, and allotype, female, Monterey Co., California, July 13, 26, 1896 (W. M. Wheeler Collection). Paratypes: male, Monterey Co., California, July 26, 1896; male, Juliaetta, Idaho, June 5, 1930 (J. M. Aldrich); female, Fairbanks, Alaska, June 29, 1921 (J. M. Aldrich); the last two in the U. S. N. M.

The specimens from the Wheeler Collection bore the manuscript name *occidentalis*, but there is no indication of who applied the name and I can find no reference to a description.

***Lonchoptera borealis*, new species**

Figure 3

Yellowish, the thorax and abdomen partly blackish in ground color; anal vein broadly separated from posterior margin of the wing; fifth vein with long bristles above. Length, 2.75 mm.

MALE.—Head yellowish, the ocellar spot black, front yellow, rather dull; frontal bristles and those along the sides of the oral margin black, the others yellow. Proboscis and palpi yellow. Antennae yellowish, with the third segment and arista brown.

Thorax reddish yellow, yellowish pollinose; mesonotum with a blackish median vitta extending almost to the apex of the scutellum, broad sublateral vittae and the sides in front of the wings brown; a streak on the mesopleura and the mesosternum brownish. Bristles black.

Legs yellowish, the apical tarsal segment brown. Front tibiae with one or two anterodorsal bristles and one posterodorsal, the latter situated near the apical third, the apical anterodorsal usually absent; middle tibiae with two anterodorsal and one posterodorsal, the latter short and situated near the basal third; posterior tibiae with two anteroventral, two anterodorsal, and one posterodorsal, the row of short posterodorsal bristles on the apical half very weak.

Wings cinereous hyaline, the veins mostly brownish. Anal vein reaching the wing margin far before the fork of the fourth vein; anal vein well separated from the posterior border of the wing; base of fifth vein with four or five strong bristles. Halteres yellow.

Abdomen yellowish, the dorsum with two very wide, pale brown vittae, leaving the base, middle and sides yellow, and bearing brownish-yellow pollen. Genitalia

rather small, the cerci convex apically, longer on the inner edges and with short, fine hair.

FEMALE.—Generally darker than the light-colored male described above. Front brownish in the middle, the dark stripes on the mesonotum wide and usually fused posteriorly, the abdomen sometimes all black, but usually with a paler median vitta. Wing venation as in other females, the sixth vein joining the fifth almost behind the fork of the fourth vein.

TYPES.—Holotype, male, Thunder River, Quebec, August 19, 1930 (W. J. Brown); allotype, female, Fairbanks, Alaska, July 1, 1921 (J. M. Aldrich). Paratypes: four males and two females, Fairbanks, Alaska, July 1, 2, 1921; male and female, Wilmington Notch, Adirondacks, New York, July 3, 1922 (J. M. Aldrich); male, Ottawa, Ontario, May 23, 1927 (Curran).

The holotype is in the Canadian National Collection, the allotype and paratypes in the United States National Museum and paratypes in The American Museum of Natural History.

The species varies considerably in color and may have the mesonotum and abdomen almost all blackish, the former with traces of two reddish vittae. *L. borealis* is very easily distinguished from the remaining species, since the anal vein is distinct and broadly separated from the posterior border of the wing behind the anal cell, and the basal section of the fifth vein bears strong bristles, a character not found in other species. The holotype is apparently abnormal in having an anterodorsal bristle near the apical third of the anterior tibiae, all the other specimens lacking this bristle. However, I have retained this specimen as the type, since it was the first to come to hand. The fact that it is known to be abnormal should eliminate confusion.

Lonchoptera dubia, new species

An extremely variable species, the thorax and abdomen sometimes all black or yellow with a dark mesonotal vitta, the head either almost all yellow or black with only the cheeks and parafacials yellow in ground color. Only the female is known. Length, 3 mm.

DARK FORM.—Head blackish, the front densely cinereous-white pollinose; vertical bristles yellowish, the upper occipital cilia black, the lower yellow. Cheeks and parafacials yellow, pale pollinose. Proboscis reddish brown, the palpi brown. Antennae black or with the basal segment yellowish.

Thorax black, gray pollinose, the scutellum not paler in ground color.

Front legs and all the femora brownish red or reddish brown; coxae dull reddish-yellow; tibiae reddish yellow, darker toward the base; posterior four tarsi yellowish with the apical one or two segments brownish. Anterior tibiae with three weak dorsal bristles, one near basal and apical third of the anterior edge, the other just before the middle posteriorly and situated fully its own length from the first anterodorsal; middle tibiae with one ventral, two anterodorsal, and one posterodorsal bristle, the ventral situated near the apical third, the posterodorsal near the basal third; posterior tibiae with two anteroventrals, two anterodorsals, one posterodorsal, and a row of short posterodorsal bristles on the apical half.

Wings cinereous hyaline, the veins mostly yellowish; sixth vein ending slightly beyond the fork of the fourth vein. All the veins, except the second, with setulae above. Halteres yellow.

Abdomen black, yellowish-brown pollinose, the venter with paler pollen.

TESTACEOUS FORM.—Head yellowish, with the ocellar triangle and sometimes the middle of the front brownish, the front with pale yellowish pollen. Mesonotum yellowish, usually with a dark central vitta, but this may be entirely absent, represented only in front, or may extend to the scutellum, in which case there may be a pair of more or less distinct lateral vittae. Abdomen yellowish, usually with evidences of a broad, median brownish vitta, but this may be entirely absent or incomplete, whereas in examples with dark thorax it may cover most of the abdomen. Legs yellowish, the front tarsi wholly brownish or with only the base reddish, the posterior four tarsi with only the apical segment blackish or brown.

The two forms described above are the extremes in coloration. The legs are somewhat darker in the dark form but display no marked differences. If the two forms represent a single species it is natural to expect intergradation in color, and this occurs among specimens collected at the same time and place. The color of the pleura varies just as does that of the mesonotum and abdomen, and with a large series it is possible to trace this variation from one extreme to the other by only slight changes between specimens in the color series.

TYPES.—Holotype, female, Cold Spring Harbor, Long Island, July 22, 1932 (Curran). Paratypes: twelve specimens, Truro, Nova Scotia, September 5 to October 11, 1913; female, Thunder River, Quebec, June 11, 1929 (W. J. Brown); nine females, Cottage Beaulieu, Quebec, July 10 to August 21, 1906 (Beaulieu); female, Montreal, Quebec, October 1, 1905 (Beaulieu); two females, Wakefield, Quebec, May 16, 1914 (C. G. Hewitt); two females, Hull, Quebec, September 25, 1923, and May 7, 1924 (Curran); female, Aylmer, Quebec, August 10, 1924 (Curran); female, Ottawa, Ontario, September 17 (J. D. Tothill); two females, Muskoka, Ontario, August, 1925 (H. S. Parish); three females, Trenton, Ontario, August 27 and September 1, 1902 (Evans); eighteen females, Brockville, Ontario, September 20 to November 1, 1903 (W. Metcalfe); female, Port Hope, Ontario, May 24, 1897 (W. Metcalfe); female, Strathroy, Ontario, September 30, 1915 (J. R. Gareau); two females, Chatham, Ontario, May 19, 20, 1925, and female, Point Pelee, Ontario, May 28, 1925 (G. S. Walley); four females, Kaslo, British Columbia, June 26 to July 17 (R. P. Currie); three females, Agassiz, B. C., April 28 and June 26, 1927 (H. H. Ross); five females, Salmon Arm, B. C., August 4 and September 21, 1925 (A. A. Dennys); female, Minnie Lake, B. C., July 27, 1925 (H. G. Crawford); female, Oliver, B. C., July 13, 1923 (C. Garrett); female, Vernon, B. C., September 26, 1918 (W. Downes); three females, Saanich, B. C., June 22 and September 11, 1918 (W. Downes); four females, Royal Oak, B. C., April 29, 1917 (R. C. Treherne), and June 30, 1917 (W. Downes); ten females, New Bedford, Mass., April 18, 22 (W. M. Wheeler), and female, August 30, 1896 (Hough); four females Readville, Boston, and Beverly, Mass.; two females Franconia, New Hampshire, and two Mt. Washington, N. H. (Mrs. Slosson); female, Georgetown, Connecticut, August 23, 1910; four females, Cold Spring Harbor, Long Island, July 22, 1932 (Curran); female, Parkville, Long Island; two females, Wilmington Notch, Adirondacks, N. Y., July 3 (J. M. Aldrich); two females, Forest Hill, New Jersey, April, May (A. J. Weidt);

four females, Newark, N. J., June (A. J. Weidt); female, Pennsylvania (W. M. Wheeler); three females, Washington, D. C. (Osten Sacken), and June 27, July 8, 1915 (V. A. Roberts); female, Black Mts., North Carolina, July; three females, Wisconsin (W. M. Wheeler); twenty females, Monterey Co., California, July, 1896 (W. M. Wheeler).

SOUTH AMERICAN SPECIMENS.—Two females, Angol, Chile, December 12, 1926, and January 1, 1927; female, Castro, Isla Chiloe, Chile, December, 1926 (R. and E. Shannon); female, San Rosendo, Concepcion, Chile, December, 1926 (R. and E. Shannon); four females, Correntoso, Rio Negro, Argentine, November, 1926 (R. and E. Shannon). Paratypes in Canadian National Collection and United States National Museum.

In American literature this species is recorded under the names *lutea* Panzer, *furcata* Fallén, *lacustris* Meigen, and *riparia* Meigen. *L. lacustris* and *riparia* are considered to be synonyms of *furcata*, the names applying to color varieties.

L. dubia cannot be *furcata* because that species is described as having the bristles of the back of the head wholly yellow, whereas in *dubia* some of the occipital cilia are black and it is only rarely that the dark bristles are reduced to one or two in number. In addition, the fact that males are entirely unknown in *dubia* is strong grounds for believing that our species cannot possibly be the same as the European. The distribution is somewhat unusual but is paralleled in the syrphid, *Allograpta obliqua* Say, which occurs in the Nearctic region and also in Argentina.

L. lutea is a larger species and usually has the vertical bristles partly black and also has different venation, the sixth vein joining the fifth under or before the fork of the fourth vein.

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RECORDS OF WESTERN BEES

By T. D. A. COCKERELL

The holotypes of all the new forms described are in The American Museum of Natural History. The bees collected by H. B. Parks are all from the southeastern part of Bexar County, Texas, except as otherwise noted.

Colletidae

Colletes oromontis Viereck

Colorado: Pine Cliffe, July 6, females (H. I. Gibbons).

Halictidae

Augochlora coloradensis Titus

Colorado: Morrison, June 15 (C. Wagner).

Halictus farinosus Smith

Utah: Provo, July 29–Aug. 1, alt. approx. 4750 ft. (Lutz); Huntsville, July 28 (Lutz); Salt Lake City, July 28 (Lutz).

Halictus lerouxii Lepeletier

Colorado: Jim Creek, near Boulder, alt. about 6400 ft., July 21 (Lutz), and Aug. 2 (Lutz), at *Rudbeckia laciniata*. Both sexes taken. This is the American representative of the European *H. rubicundus* Christ, and it is questionable whether they should be kept apart. In the punctured tegulae of both sexes, and dentate hind spur of the female, *H. rubicundus* agrees with *lerouxii*, and not with the very similar *H. farinosus* Smith. In *H. rubicundus* the hind tibiae and tarsi of the female are clear red, and this is true of *H. lerouxii* variety *ruborum* Ckll., described from the State of Washington. The case is closely parallel with that of *Clisodon*.

Halictus parallelus Say

Colorado: White Rocks, near Boulder, alt. about 5200 ft., Aug. 13 (Lutz).

Halictus sisymbrii Cockerell

Wyoming: Medicine Bow, June 23, alt. approx. 6600 ft. (Lutz); Pine Bluffs, June 9, alt. approx. 5050 ft. (Lutz); Laramie, June 14, alt. approx. 7200 ft. (Lutz).

Andrenidae***Andrena anograe* Cockerell**

Colorado: Princeton Hot Springs, June 16 (C. Wagner); Salida, June 20 (C. Wagner).

***Andrena colletina* Cockerell**

Colorado: Gardner, alt. approx. 7000 ft., Sept. 20–Nov. 18 (W. Granger). It must have been taken at the beginning of the period cited. The spurs are white. One female.

***Andrena erythrogastra* (Ashmead)**

Colorado: Salida, at flowers of *Salix*, June 19 (Ckll.).

***Andrena hitai* Cockerell**

Colorado: Poncha Pass, June 26 (Ckll.).

***Andrena lupinorum helenae*, new subspecies**

FEMALE.—Length about 14 mm.; black, robust, the mandibles, antennae and tegulae black; malar space very short; facial quadrangle broader than long; process of labrum truncate, only moderately broad, narrower than in *A. lupinorum*, and in front of it are two long slender pencils of red hair, lacking in *A. lupinorum*; third antennal joint a little longer than the next two together, these being about equal in length; facial foveae broad, light reddish, narrowly separated from eye, ending below near level of top of clypeus; clypeus densely and strongly punctate, the punctures tending to run in grooves, a distinct impunctate median line; hair of face thin and reddish brown, more brightly colored at sides and near antennae, but clear red on top of head; on cheeks it is rusty black, with a few coppery-red hairs, and a tuft of red at lower end; mesothorax and scutellum dull; the entire thorax above, and the tubercles, densely clothed with very bright fox-red hair, which also clothes metathorax, though here the color is not so rich; sides of thorax with purplish-black hair; wings hyaline, slightly dusky, the margin beyond the cells perceptibly darker; stigma narrowly lanceolate, red with a dark margin; nervures pale brown; basal nervure meeting nervulus; second cubital cell rather narrow, contracted above, receiving recurrent nervure beyond middle; third cubital very broad above, about twice as broad on marginal as second (in *lupinorum* the third is not as broad on marginal as second, and the second is much larger); hind wing with 14 hooks (13 in type of *lupinorum*); legs with mainly black hair, the scopa of hind tibiae entirely black; front femora with long pale reddish hair behind, hind femora with similar hair in front; short fringe on anterior basitarsi posteriorly appearing silvery; spurs dark rufous; abdomen broad, shining, finely and weakly punctured, without bands, the hair all black (slightly reddish black at apex), the dorsal hair of third and fourth tergites very short; second tergite in middle depressed about or rather over a third; venter with long black hair.

Colorado: South St. Vrain River, Lyons, July 9, 1933 (Helene I. Gibbons). In all respects very close to *A. lupinorum* Ckll., but appearing

distinct on account of the richly colored thorax, and with differences in venation and the process of labrum. I treat it for the present as a subspecies; the discovery of the males will doubtless enable us to settle the relationships of the two forms more precisely.

***Andrena mentzeliae* Cockerell**

Colorado: Pueblo, Aug. 9, alt. approx. 4700 ft. (Lutz).

***Andrena pertarda* Cockerell**

Colorado: Aspen, alt. approx. 8000 ft., July 24–27 (Pearce Bailey). The abdominal hair-bands are yellower than in the type.

***Andrena prunorum* Cockerell**

Colorado: Princeton Hot Springs, June 16 (W. P. Cockerell); Salida, June 19 (Ckl.). The last was at flowers of *Salix*.

***Andrena ribifloris* Viereck and Cockerell**

Colorado: Poncha Pass, June 20, at *Ribes* (Ckl.).

***Andrena spaldingi*, new species**

FEMALE.—A species of the *A. vicina* group, superficially exactly like *A. lupinorum helenae*, with very bright red hair on thorax above, but differing as follows: hair of head entirely black, except a tuft of long pale red hair on vertex; flagellum very obscurely rufescent beneath; mandibles rufous at extreme tip; hair of metathorax, as well as pleura, black; wings dilute fuliginous throughout; stigma very dark reddish; second cubital cell large, broader than high, receiving recurrent nervure about middle; third cubital cell narrower than second on marginal; hair of legs entirely black; spurs black; second tergite more broadly depressed in middle. Process of labrum rather narrowly truncate, with sloping sides; clypeus very densely rugosopunctate, with a median smooth ridge; third antennal joint about as long as next two together; facial foveae similar to those of *A. lupinorum helenae*, but not reddened, though appearing pallescent in certain lights.

Utah: Eureka, May 31, 1920 (Tom Spalding).

***Andrena vicina* Smith**

Colorado: Pine Cliffe, July 6, female (H. I. Gibbons).

***Nomia apache* Cresson¹**

Texas: Bexar Co., two females, June 14 (Parks).

This is easily distinguished at a glance from any of the *N. heteropoda* series by the polished first tergite, with widely separated punctures.

¹Mr. E. T. Cresson, Jr., has kindly examined the holotype of *Nomia apache*, and reports that the first tergite has much more scattered punctures than has that of *N. marginipennis*; the smooth surface between the punctures averages about two to three times the diameter of the punctures on the median area of this segment. This confirms my revised determination of *N. apache*.

The ventral hair of the abdomen is light red. Previously (Amer. Mus. Novitates, No. 433, p. 10) I have misidentified *N. apache*, applying the name to specimens of the *N. heteropoda* series which had pale reddish tegulae, wings yellowish with dark border, and hair of thorax above pale fulvescent or rufofulvous.

This species was found by Mr. Parks visiting *Ratibida columnaris* (Sims), the bodies being covered with the bright yellow pollen.

***Nomia bakeri* Cockerell**

A large colony of *N. bakeri*, east of Denver, was studied during the past summer, and cinema pictures were taken by Mr. Robert Niedrach of the Colorado Museum of Natural History. Bombyliid flies (*Heterostylum robustum* Osten-Sacken, det. M. James) were abundant, hovering over the nests, and two species of Mutillidae (*Dasymutilla occidentalis* var. *comanche* Blake and *D. sparsa* Fox, both det. Mickel) were observed. Numerous specimens of *Bembix spinolae* Lepeletier were nesting in the same place. The *Nomia bakeri* were found collecting pollen only from *Grindelia*. *Helianthus petiolaris*, very abundant all about, was never visited.

***Nomia fedorensis* Cockerell**

Texas: Bexar Co., males June 4–July 12, females, May 20–June 4 (Parks). Mr. Parks found this in a sandy region, working only on one species of plant, the one-leaved bean.

Mr. Parks writes: "This beautiful little bee seems to work almost altogether on the one-leaved bean, *Dolicholus americanus* (Miller). I have seen literally hundreds of them, but they are very hard to catch as the beans grow in the soft white sand and the bees will not rise if they are covered by the net, but will run under the edge of the net. The only way to get them is to put the bottle directly over the insect on the flowers. I have seen the males visit *Cassia*; however they do not seem to feed, but are simply investigating. This bee seems to be solitary with its nest, which is placed generally right in the rut which is made by the automobile wheels in the sand where the public roads cross the sand dunes. I have tried to dig these out, but have never been able to follow the tunnel through the soft sand."

***Nomia heteropoda* variety *valida* (Say)¹**

Many years ago, Viereck suggested that the *Andrena valida* of Say was really a species of *Nomia*. A series of five females, taken by Mr.

¹I find that Cresson ('Types of Hymenoptera') designates the male of *Nomia marginipennis* as the type. Thus it is possible that the form represented by the female will require a new name.

Parks in Bexar Co., Texas, June 24-July 13, is referable to the subgenus *Dieunomia*, and is, I feel sure, representative of the insect which Say called *Andrena valida*. It is a large species, with black pubescence, and dark fuliginous wings. The abdomen is without bands. To be associated with this are two males with equally black pubescence, and the structural characters of *N. heteropoda* (Say). These have the wings fuliginous throughout, like the females. In both sexes, the tegulae are black. The hair on the face of the males is of a dark chocolate color. The males are dated June 24 and July 13. Two other males, dated June 27 and July 11, are structurally similar, and have the same fuliginous wings and black tegulae, but the hair of the face is dull white; that of the vertex, cheeks, thoracic dorsum, pleura, and fringe on front legs pale grayish-brown. Another male, dated June 26, is similar to the last mentioned, except that the anterior wings are yellowish hyaline, with a very weak broad apical border. The hair on inner side of hind basitarsi is distinctly red. This third form of male exactly agrees with the description of *Nomia heteropoda* Say. I can only conclude that *Andrena valida* (1837) is the female of *N. heteropoda* (1824), but the name *valida* applies to the black variety, which deserves to be distinguished. In the collection of the Philadelphia Academy the female standing under *N. heteropoda* has uniformly fuliginous wings, and the question naturally arises, whether there is any female with yellowish, dark-bordered wings, corresponding with the *heteropoda* form of male. Such a female, with dark tegulae, and the hair of thorax very dark seal-brown, is the *N. marginipennis* (Cresson). The female *marginipennis* is first described, and I designate it as the type. But on comparing the descriptions of male *marginipennis* and *heteropoda*, no difference is apparent, except that the former appears to have the pubescence more ochraceous, not so gray. I conclude that *N. marginipennis* is specifically identical with *N. heteropoda*.

The second variety of the male, with fuliginous wings but hair as in *heteropoda*, may be called variety *semivalida*, new variety.

Females from Crowley and Olney, Colorado, Sept. 1 (M. T. James), which I had referred to *N. apache* Cresson, have orange wings with dark border, dark tegulae, and the fine dense tomentum of mesothorax is pale grayish-fulvous. The hair on under side of abdomen is very dark brown. This is not the real *N. apache*, but belongs to the *heteropoda-marginipennis* series, differing by the pale hair of thorax above, as in the described males.

This could be regarded as the true female of *N. heteropoda*, i.e., strictly corresponding with the male. The females of this series would accordingly fall into three color-varieties, as follows:

Wings entirely fuliginous; pubescence black	<i>valida</i> (Say).
Wings orange or yellowish with broad dark border	
Pubescence dark	<i>marginipennis</i> (Cresson).
Pubescence largely pale	. . . . <i>heteropoda</i> (Say).

All the specimens obtained from Mr. Parks came from the same locality, were collected at about the same time of year, and were visiting flowers of *Helianthus annuus* Linnaeus.

***Nomia heteropoda semirubra*, new subspecies**

FEMALE (type).—Tegulae light fulvotestaceous; dense tomentum of thorax above ferruginous; wings yellowish with a broad dark border; hair on under side of abdomen black or rusty black.

MALE.—With the same coloration of tegulae, dorsal pubescence and wings.

Texas: type (formerly recorded as *N. apache*) from Victoria, Oct. 2, at flowers of *Helianthus* (Leisler); two females, Bexar Co., Oct. 27 (Parks); males from Bexar Co. are dated Oct. 6 and 12.

The Bexar Co. specimens were collected from *Helianthus annuus*, and were numerous at one place, about twenty miles from the locality of *H. heteropoda* variety *semivalida*.

***Nomia heteropoda atripennis*, new variety**

FEMALE (type).—Tegulae ferruginous; hair of thorax above red; wings entirely fuliginous; hair on under side of abdomen black.

MALE.—With the same coloration of tegulae, dorsal pubescence and wings.

Texas: Bexar Co., Sept., Oct. (Parks). Taken at *Monarda punctata*, in the heart of the sand dune country, where it was quite common.

This seems to be more than a color-variety of *N. heteropoda*. The females average smaller, and the insect flies much later in the season.

The western *N. xerophila* (Ckll.), with reddish or pale hair on under side of female abdomen, is apparently to be regarded as another subspecies, *N. heteropoda xerophila*. It flies in September.

***Nomia mesillae* (Cockerell)**

Texas: Laredo, May 18, male. Received from H. B. Parks.

So far as I can now judge, this cannot be separated from *N. apache*, which has been known only from the female.

Males only were collected, in the heart of the sand dune country, on *Pentalostemon microphyllus*, which Mr. Parks finds is a favorite plant of the species of *Nomia* in Texas. *N. mesillae* seems to be very rare in this region, and "probably belongs to a great group of either wandering, or blown in, insects which visit this section from the south each summer."

Nomia nortoni Cresson

Texas: Bexar Co., males July 12 to Sept. 27; Medina Co., June 25, female (Parks).

Mr. Parks reports as follows concerning the nesting-sites of *N. nortoni*:

I happened to hear of these nests from the fact that the Mexicans were unable to drive the teams with which they were cultivating corn through these towns due to the great number of bees, and appealed to me for a remedy. I suggested that the cultivating which the bees were giving the land was far more beneficial than the scratching which was being done with the cultivators, and the farmers ceased to attempt to cultivate these spots, and not strange to say the corn in these two places was almost one third larger than the other corn, this being of course due to the fact that the ground was perforated with hundreds of holes to the depth of fourteen to sixteen inches.

This is the most common species of the genus in the region about San Antonio. It has been observed by Mr. Parks visiting 83 species of plants, but it gets most of its pollen and nectar from *Petalostemon microphyllus* Torrey and Gray, *Monarda punctata* Linnaeus, and *Brazoria truncata* (Bentham). Mr. Parks adds: "It is periodic. The periods seem to be about three years in length." It is most abundant where the soil is sandy.

Nomia parksi, new species

FEMALE.—Length about 8.5 mm., anterior wing about 7.3; black, tergites 2 to 4 with broad, even, light green bands, slightly flushed with red; pubescence rather dull white, clear white on face, cheeks and pleura; tegulae small, shining black; stigma dusky, ferruginous, with a darker margin. Easily known from *N. fedorensis* by the paler, less brilliantly colored abdominal bands, first tergite much more feebly and sparsely punctured, and flagellum black, with only a faint reddish tinge at end. It is close to *N. mesillensis* Ckll., but easily separated by the first tergite, which is dull, with a minutely tessellate surface, and sparse large shallow punctures; in *mesillensis* it is highly polished. The abdominal bands are not as broad as in *mesillensis*, and the raised part of second tergite has its posterior border subangulate (quite straight in *mesillensis*). The region before this border is dull; in *mesillensis* it is highly polished. Compared with *N. maneei* Ckll., the band on second tergite is much broader, and the white hair at margin of sides of first is conspicuously longer. The tegulae and antennae are also differently colored. The black tegulae and color of abdominal bands separate it from *N. waldensis* Ckll., though there is a resemblance in the first tergite. The legs are black, without the red color seen in *N. waldensis*. The stigma is conspicuously larger and longer than in *N. fedorensis*, and the second cubital cell receives the recurrent nervure in the middle, but much beyond the middle in *N. fedorensis*. The transverse channel at base of metathorax is narrow and feebly sculptured, mandibles black, with an obscure reddish stain subapically. Wings hyaline, not at all reddish, faintly dusky beyond the cells.

Texas: Bexar Co., May 25, 1931 (H. B. Parks).

This species was collected with *N. fedorensis* and was not distinguished at the time.

Oxaeidae

Protoxaea texana (Friese)

Texas: Southeast Bexar Co. (H. B. Parks). Mr. Parks finds the bee visiting *Monarda punctata* Linnaeus and *Aloysia ligustrina* (Lagasca). The females are numerous in the sand dunes on *Monarda*, but males were found only on *Aloysia*.

Panurgidae

Halictoides maurus (Cresson)

Colorado: Pingree Park, Aug. 18 (Louise Ireland). This bee has collected a quantity of remarkable lilac-colored pollen.

Perdita albipennis Cresson

Colorado: Inspiration Point, near Denver, July 2 (H. I. Gibbons).

Protandrena mexicanorum (Cockerell)

Texas: one female collected by H. B. Parks, near San Antonio.

Spinoliella australior (Cockerell)

Colorado: Canfield, Aug. 15, 1922 (Lutz).

Spinoliella scitula (Cresson)

Colorado: White Rocks, near Boulder, alt. about 5500 ft., at *Cleome serrulata*, July 30 (Lutz); Denver, July 24 (L. O. Jackson).

Spinoliella zebrata (Cresson)

Colorado: Golden, June 30, 1918, both sexes (L. O. Jackson).

Anthophoridae

Ancylosceles maculifera, new species

MALE.—Length about 7.3 mm.; black, with white hair; clypeus finely punctured, shining, entirely black; labrum shining and well punctured, seen from in front appearing black, but having a large transverse white mark, conspicuous when seen from a lower position, where the hair does not conceal the surface; mandibles black at tip, then bright red, and the basal part broadly yellowish white; flagellum obscurely reddish beneath, and above at apex; mesothorax dullish, very finely punctured; tegulae very dark reddish; wings clear hyaline, stigma rather dusky red, with a dark margin; small joints of front and middle tarsi red, hind tarsi chestnut red, the basitarsi with a large thorn-like process; hind femora greatly swollen; abdomen with

white hair-bands, the first two failing in middle; bases of fourth and fifth tergites obscurely reddish.

Texas: Bexar Co., May 6, 1932 (H. B. Parks). Also labelled "nest." In my key in Proc. Calif. Acad. Sci., June 1923, p. 84, this runs to *A. toluca* (Cresson), which has the hind femora much less robust, and the process on hind basitarsi much smaller. If regarded as having a black labrum, it would run to *A. globulifera* (Ckll.), which has the legs entirely dusky red, the femora less robust, the abdominal bands much less developed, and the wings grayish. The abdominal bands are pure white, not yellowish as in *A. wheeleri* (Ckll.). *A. armata* (Smith) is easily separated by the entirely light labrum, and the light band of clypeus.

The only species previously recorded from the United States (*A. sejuncta* Ckll., 1933, from Colorado) is related, but has an entirely black labrum, and no light spot on mandibles.

***Anthedon compta* (Cresson)**

Texas: Bexar Co., June 13, male (H. B. Parks).

***Clisodon furcatus* (Panzer)**

Wyoming: Camp Roosevelt, Yellowstone Park, July 14-17, 1923, female (American Museum). This specimen has the light hair of thorax above strongly fulvescent, and nearly agrees with a specimen from Berlin. It differs, however, in the broad band of black hair along hind margin of hind tibiae, and in general has a more melanic appearance than normal *C. terminalis* (Cresson), in some degree approaching *C. syringae* Cockerell. All these bees appear to be races of one species, which is Holarctic in distribution. (See also Pan-Pacific Entomologist, I, p. 50.)

***Emphoropsis johnsoni* Cockerell**

Colorado: Apex Canyon, Golden, May 1, male (L. O. Jackson).

***Melissodes atraticornis*, new species**

MALE.—Length about 9.5 mm., anterior wing about 8; black, with abundant long rather dull-white pubescence; no dark hairs on vertex, but a row of black hairs on scutellum; antennae very long (flagellum about 8 mm.), entirely black; facial quadrangle distinctly higher than broad; eyes (dry) bluish gray; clypeus short and broad, light yellow, with a black lower margin, and a black mark on each side above; labrum (except for the white hair) entirely black; mandibles black; mesothorax and scutellum moderately shining, the mesothorax polished on disc; tegulae black; wings hyaline, very faintly reddish, nervures dark brown; basal nervure falling far short of nervulus, the distance equal to much more than half of nervulus; second cubital cell large and very broad, receiving recurrent nervure at about the beginning of its last third; legs with abundant white hair, pale reddish on inner side of tarsi;

abdomen somewhat shining; the hind margins of tergites colorless; very abundant long white hair all over first tergite; tergites 2 to 5 with loose irregular hair-bands; apical plate broadly truncate, dark brown; the usual small dark spines at sides of last two abdominal segments.

Colorado: Pingree Park, Aug. 14, 1933 (Louise Ireland). Related to *M. fremonti* Ckll., but smaller, with narrower face, differently colored eyes, and basal nervure much more remote from nervulus.

***Melissodes atripes* Cresson**

Texas: Bexar Co., both sexes, the female Sept. 27 (H. B. Parks).

***Melissodes obliqua* (Say)**

Texas: near San Antonio, male June 10, female May 22 (H. B. Parks).

***Melissodes suffusa* Cresson, variety *laterufa*, new variety**

FEMALE.—A peculiar variety, with the margin of first tergite broadly hyaline, and the following tergites with the tegument red under the broad bands, the red part of second and third tergites in middle being much broader than the black base; mesothorax with rich fulvous hair, and almost no dark, but much dark brown hair on scutellum; vertex with bright fulvous hair, but face and cheeks with white; labrum dusky red, with a tuft of red hair at apex; flagellum red beneath. The general appearance of the abdomen is that it is black as far as middle of second tergite, and pale red beyond, with the bases of tergites blackish.

Texas: Bexar Co., Oct. 11, 1932 (H. B. Parks). It seems appreciably more robust than ordinary *M. suffusa*. There is quite a strong resemblance to *M. townsendi* Ckll., from New Mexico, of which only the male is known. *M. townsendi* has lighter, redder, nervures and stigma, but it is possible that *laterufa* is a form of the female of that species, rather than of *M. suffusa*.

***Melitoma grisella* (Cockerell and Porter)**

Colorado: La Junta, Aug. 12, alt. 4100 ft., females (Lutz).

This species nests in banks; the earthen porch protecting the entrance to the nest has a slit above, as in *Anthophora*, but the structure is more irregular, and is attached to the surface of the bank throughout its length, instead of standing out, with a downward curvature, as in *Anthophora*.

***Xenoglossodes albata* (Cresson)**

Colorado: Gregory Canyon, Boulder, Aug. 4 (E. Nelson).

***Xenoglossodes pallidicauda*, new species**

FEMALE.—Length about 9 mm.; robust, black, head and thorax with copious, entirely white hair; clypeus densely punctured, entirely black; labrum with abundant slightly yellowish hair; mandibles short and stout, mainly light red, but black at apex, and at base with a triangular yellow spot above; eyes dark brown; facial quadrangle about square; flagellum bright red beneath except at base; vertex shining; disc of mesothorax shining, with well separated punctures; scutellum closely punctured, dullish; tegulae black with reddened margins, or nearly all reddish: wings short, clear hyaline, stigma and nervures reddish; legs with copious white hair, tuft on hind knees pale reddish; abdomen with long white hair on first tergite, which has a broad hyaline margin; second tergite with a broad dense creamy white apical band, a dark (exposed) zone before it about equally broad, and a basal white band; rest of abdomen densely covered with creamy white hair, except that across middle of third tergite it is thin, so that a dark band is more or less evident; hair of apex all yellowish white; venter with white hair.

Texas: southeast Bexar County, two collected by Mr. Parks, who finds it very common at flowers of *Ximenesia encelioides* Cavanilles.

In my key to *Xenoglossodes* this runs to *X. excurrens* Ckll., which is considerably larger, with dark hair at end of abdomen. There is a close resemblance to *X. gutierreziae* Ckll., but that has the light margin of first tergite much narrower, and a broad light yellow band on clypeus. *X. eriocarpi* Ckll. has the broad marginal band on first tergite, but it has a yellow band on clypeus. I had united *Xenoglossodes* with the Old-World *Tetraloniella*, but Mr. Timberlake finds differences in the genitalia, and it may well be that they should be kept apart. *X. pallidicauda* has five-jointed maxillary palpi.

Melectidae***Bombomelecta fulvida* (Cresson)**

Colorado: Morrison, June 15 (C. Wagner); Swissvale, at *Pentstemon*, June 17 (Ckll.).

***Epeolus americanus* (Cresson)**

Colorado: Ward, alt. approx. 9300 ft., June 25, 1922 (Lutz); Electra Lake, alt. approx. 8400 ft., June 28–July 1 (Lutz); Summit Road, Ouray, alt. approx. 10,000 ft., July 13 (Lutz); Wolf-Fall Creeks, Mineral Co., alt. approx. 7900 ft., June 20 (Lutz).

This is the *Phileremus americanus* of Cresson, which is an *Epeolus* with only two cubital cells. The type of *Phileremus* is *P. punctatus* (Fabricius), a very different (European) insect.

There are two other species of so-called American *Phileremus*, which now stand as follows:

(1).—*Epeolus mesillae* (Cockerell); *Phileremus mesillae* Ckll. 1895.

(2).—*Epeolus montanus* (Cresson); *Phileremus montanus* Cresson, 1878.

E. montanus, from Cresson's description, is a relative of *E. asperatus* Ckll. (California), the type of which has only two cubital cells on one side, and on the other only the lower third of the second intercubitus. The recently described (European) *E. montanus* Bischoff will have to be renamed.

Epeolus americanus has two-jointed maxillary palpi, the second joint very small.

***Epeolus olympiellus* Cockerell**

Idaho: Craters of the Moon, June 18, male (Louise Ireland).
Previously known from Washington State.

***Holcopasites lutzi*, new species**

MALE.—Length a little over 7 mm.; robust, black, with the pubescence white; eyes pale brown; face broad; dense white hair at sides near antennae, and more narrowly across lower end of supraclypeal area, forming a sort of band; clypeus excessively densely punctured, with a shining margin; labrum black, with a band of white hair, and a small basal appressed spine-like structure; mandibles dusky red, black at end; flagellum dusky red beneath; vertex broad and dull, with a minute shining spot on each side, simulating an extra pair of ocelli; a thin band of dull white hair extends up to middle ocellus, and behind ocelli a band of scattered pale fulvescent scales extends back to occipital margin, and is in a line with an exactly similar band on middle of mesothorax, which however is lacking on nearly the posterior half, though continued across the rough bigibbous scutellum; tubercles red; mesopleura dull black, with only a small spot of light hair in middle; tegulae rather dark red; wings dilute fuliginous, with dark stigma and nervures; first recurrent nervure meeting first intercubitus; legs mainly black, the grayish pubescence on hind tibiae producing a speckled effect; anterior tibiae red at each end, and rufescent in front; middle tibiae red at extreme base, and slightly so at apex; hind knees red; tarsi dark; abdomen broad, hind margins of tergites with bright red bands; basin of first tergite sharply defined, angulate above, and with a shining sulcus in middle; first tergite dorsally with a pair of elongate white hair-spots; tergites 2 to 6 each with four spots; apical plate brown; venter with fine whitish tomentum.

Colorado: Wray, Aug. 17–19, 1919, alt. approx. 3700 ft., in canyon, (Lutz). Related to *H. heliopsis* (Robertson) and *H. robertsoni* Crawford, but considerably larger, with the pleura differently marked, and other differences. The pattern of the abdomen is much like that of *H. heliopsis*.

***Holcopasites pulchellus* (Cresson)**

Colorado: Denver, June 18, 1918 (E. C. Jackson).

***Pseudomelecta miranda* (Fox)**

Colorado: Erie, June 27 (W. P. Ckll.).

Megachilidae***Anthidium emarginatum* Say**

Colorado: Poncha Pass, June 20 (Ckll.).

***Anthidium tenuiflorae* Cockerell**

Colorado: Princeton Hot Springs, June 16 (Ckll.); Salida, at *Peritoma serrulatum*, June 19 (Ckll.).

***Lithurgus apicalis* Cresson**

Colorado: Swissvale, June 17, males, three at flowers of *Opuntia* and one at *Pentstemon*, the last unusually small.

***Monumetha albifrons* (Kirby)**

Colorado: Pine Cliffe, July 6, male (H. I. Gibbons).

***Osmia armaticeps* Cresson**

Colorado: Poncha Pass, June 20 (Ckll., C. Wagner).

***Osmia bruneri* Cockerell**

Colorado: Swissvale. at flowers of *Pentstemon*, June 17 (Ckll.); Turkey Creek, Morrison, June 19 (H. I. Gibbons).

Idaho: Craters of the Moon, June 18, both sexes (Louise Ireland).

***Osmia bucephala* Cresson**

Colorado: Poncha Pass, June 20 (W. Steele, C. Wagner).

***Osmia cobaltina* Cresson**

Idaho: Craters of the Moon, June 18, female (Louise Ireland).

***Osmia fulgida* Cresson**

Colorado: Maysville, June 18 (Mildred Steele); Pingree Park, female, Aug. 15-17 (Louise Ireland, H. I. Gibbons).

Idaho: Craters of the Moon, June 18, male (Louise Ireland).

***Osmia gaudiosa* Cockerell**

Colorado: Swissvale, June 17 (Mildred Steele). One was at flowers of *Pentstemon*.

***Osmia holochlora* Cockerell**

Colorado: Princeton Hot Springs, June 16 (C. Wagner).

This is separated from *O. gaudiosa* (males) thus:

- Second cubital cell receiving second recurrent nervure much nearer apex than first to base.....*gaudiosa* Ckll.
 Second cubital cell receiving recurrent nervures about equally far from base and apex; face strongly brassy.....*holochlora* Ckll.

***Osmia hypochrysea* Cockerell**

Colorado: Poncha Pass, June 20 (C. Wagner, Walter Steele).

***Osmia louisae*, new species**

FEMALE.—Length, 12 mm.; robust, brilliant purple-blue on face, cheeks and sides of thorax, suffused with green on vertex and disc of mesothorax, the abdomen shining and distinctly green; pubescence long and coarse, entirely black; mandibles quadridentate, black with a green suffusion at base; face broad; clypeus dull and excessively densely punctured; vertex very broad behind ocelli; tegulae green, black posteriorly; legs blue, suffused with green; base of metathorax somewhat shining, but not polished; wings strongly dusky (grayish) throughout, without any cloud in marginal cell; first recurrent nervure joining second cubital cell very near base, second more than twice as far from apex; basal nervure falling a trifle short of nervulus.

Idaho: Craters of the Moon, June 18, 1933 (Louise Ireland). Superficially exactly like *O. ribifloris* Ckll., but with no trace of a smooth line on clypeus, hind margin of first tergite broadly smooth, no cloud in marginal cell. The venation is very different; in *O. ribifloris* the first recurrent nervure ends far from base of second cubital cell, the distance about equal to length of first intercubitus; while the second recurrent ends very near the apex of the cell.

***Osmia megacephala* Cresson**

Colorado: Steamboat Springs, July 21 (H. I. Gibbons).

***Osmia nifoata* Cockerell**

Colorado: Poncha Pass, June 20 (C. Wagner); Princeton Hot Springs, June 16 (C. Wagner); Maysville, June 18 (Mildred Steele).

***Osmia nigrifrons* Cresson**

Colorado: Morrison, June 15 (C. Wagner); Princeton Hot Springs, June 16 (C. Wagner).

***Osmia pentstemonis* Cockerell**

Colorado: Poncha Pass, June 20 (C. Wagner).

***Osmia wardiana* Cockerell**

Colorado: Poncha Pass, June 20 (Ckll., W. Steele, C. Wagner);
Maysville, June 18 (Ckll.).

Maysville is in Chaffee County, alt. 8310 ft.

Bombidae***Psithyrus insularis* Smith**

Colorado: Maysville, June 18 (Ckll.); Steamboat Springs, July 20
(H. I. Gibbons).

Apidae***Apis mellifera* Linnaeus**

Colorado: Salida, at Salix, June 19 (Ckll.). Form with black
abdomen.

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A NEW FOSSIL ZALAMBODONT INSECTIVORE

BY ERICH MAREN SCHLAIKJER¹

In 1903, Dr. W. D. Matthew described a partially complete left lower jaw of a fossil zalambdodont insectivore which he named *Apternodus mediaevus*. In 1910 he gave a brief description (pp. 33-36) of an unusually complete skull and left lower jaw which he referred to the same genus and species. In my recent study of a new fossil zalambdodont, *A. gregoryi*, I mentioned that I had not had the opportunity of studying this very fine specimen. It was in the University of Wyoming Museum but was reported as lost. Since that time, fortunately, it has been found and has been acquired by The American Museum of Natural History. The specimen presents a sufficient number of peculiar characteristics, not mentioned by Dr. Matthew, to warrant an additional description. Also, since Dr. Matthew's paper, enough information about this genus has been brought to light by the discovery of new material to determine this specimen as representing a species different from those previously described.

Through the courtesy of Dr. G. G. Simpson, the specimen has very generously been offered to me for reëxamination, by the Department of Vertebrate Palaeontology of the American Museum. The results of this study are the subject of this article. The drawings were made by Mrs. H. Ziska.

Order **INSECTIVORA**

Family **SOLENODONTIDAE**

Subfamily **Apternodontinae**

Apternodus brevirostris, sp. nov.

TYPE.—Amer. Mus. No. 22466. Nearly complete skull and left lower jaw. Collected by Mr. W. H. Reed for the University of Wyoming.

HORIZON AND LOCALITY.—Lower Oligocene, *Titanotherium* beds. Collected in the neighborhood of Bates's Hole, north of the Laramie Plains, Wyoming.

SPECIFIC CHARACTERS.—The type material of *A. mediaevus* being so fragmentary, I deemed it advisable in my description of *A. gregoryi* to consider only those characters as specific which were different from those seen in *A. mediaevus*. They were as follows: jaw larger and more massive; coronoid heavier, more antero-posteriorly

¹Museum of Comparative Zoology, Cambridge, Massachusetts.

expanded, and more external to the tooth row; M_{2-3} series longer; M_2 shorter, wider and heavier, talonid more reduced and paraconid more lingually situated with respect to the metaconid; M , longer and slightly higher and talonid larger; and mandibular condyle much wider and heavier. All of these characters in *A. brevirostris* are intermediate between those of *A. mediaevus* and *A. gregoryi*. The differences, then, among

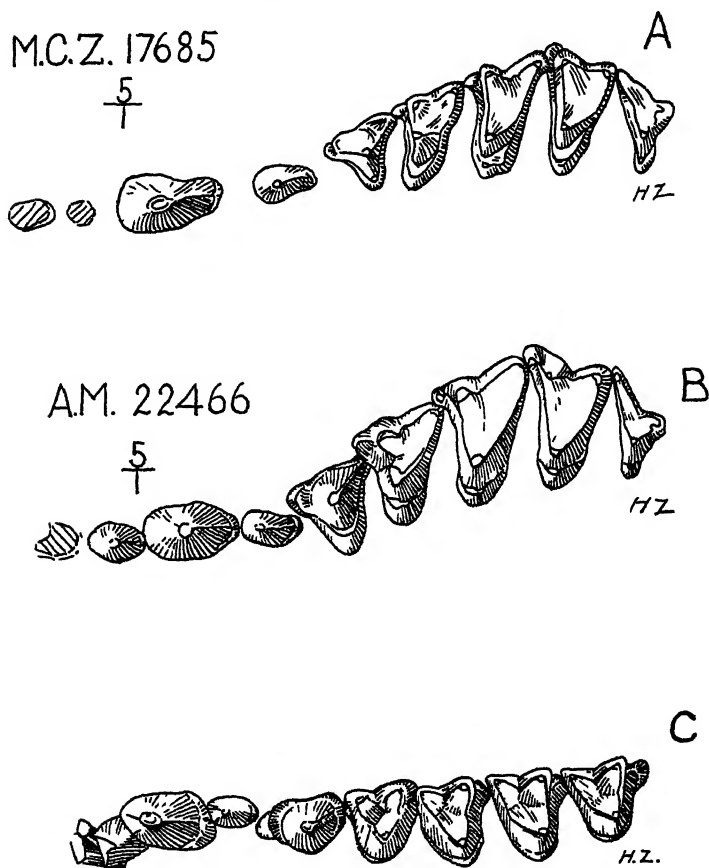


Fig. 1. A, left upper cheek-teeth of *Apternodus gregoryi* Schlaikjer. M. C. Z. 17685. B, left upper cheek-teeth of *A. brevirostris*, new species. A. M. 22466. C, left lower cheek-teeth of *A. brevirostris*, new species. A. M. 22466. All drawings five times natural size.

these three species, so far as the posterior part of the lower jaw with the last two molar teeth is concerned, seem to be one of degree. While, on the basis of the characters listed above, *A. brevirostris* and *A. gregoryi* appear to be rather closely similar, they are strikingly different in many skull characters. It would seem, therefore, that those differences in the last two inferior molar teeth which appear to be minor in

importance are of greater specific value than would normally be inferred. The more important characters in which *A. brevirostris* is different from *A. gregoryi* are the following: 1. Postorbital region much longer. 2. Face in front of antorbital bar shorter. 3. Auditory region more widely expanded, especially across the region of the post-glenoid processes. 4. Auditory plate of greater antero-posterior length, and does not descend as sharply along the dorso-anterior margin. 5. Skull higher above M^1 . 6. Palate proportionately broader across Ms^1 . 7. Constriction of the face across the maxillaries from M^1 to C more abrupt. 8. No diastema between the last upper incisor and the canine, or between the canine and P^2 or between P^2 and P^3 . 9. Upper canines smaller. 10. P^4 larger. 11. Protocones (especially on M^1) conical, and much larger than hypocones. 12. M^{1-2} longer and wider. 13. P_3 with continuous external cingulum. 14. Condyle of lower jaw much narrower. 15. Anterior region of mandible deeper.

DESCRIPTION

DENTITION

The incisor formula of *Apternodus* has never been definitely known. The anterior tips of the premaxillaries are broken away, hence the exact number of upper incisors cannot be determined. It is very probable, however, that there were only two. They are single-rooted and the last is closely set against the canine. As in *A. gregoryi* the canine is two-rooted, though proportionately smaller and not as tall-crowned. P^2 is two-rooted and not one-rooted as stated by Matthew. The rest of the upper cheek-teeth are similar to those of *A. gregoryi*, though they present a number of differences of proportions. Especially noteworthy is the large size of P^3 , and the conical protocones which are larger than the hypocones.

The most striking dental feature of this specimen is the presence of a very minute second lower incisor tooth which is wedged between the enlarged semi-procumbent first incisor and the fairly large I_3 . The lower incisor formula can now be considered definitely as I_3 . I_2 is peg-like, and is so small that it can scarcely be seen with the naked eye. Its alveolus is confluent with that of I_1 which is the largest of the incisors. I did not record the presence of this tooth in *A. gregoryi*. Since my study of that species, I have reexamined the specimen, and by excavating in the mandible just posterior to the enlarged incisor I discovered the tip of a minute tooth root. I_2 , therefore, was also present in this species. The crown of I_1 is broken away, but the root indicates that the tooth was oval in outline, being somewhat laterally compressed. I_3 is smaller than I_1 , and the crown is low, oval and flat. The reduction of I_2 instead of I_1 or I_3 is a unique character. I am aware of this condition in no other zalambdodont, and its occurrence is most unusual among other mammals.

Another character of *Apternodus*, equally unique among zalambdodonts, is the enlargement of I_1 . This is probably the result of the reduction of I_2 , which is ordinarily the larger incisor in this group of insectivores.

SKULL

The facial portion of the skull is strikingly abbreviated, while the postorbital area is very much elongated. There is a slight postorbital constriction as in *A. gregoryi*, but the skull is higher above M^1 and the palate is proportionately broader across the first molars. Also, the constriction of the face from M^1 to the canine is more abrupt and the malar projection on the maxillary is much more prominent. The depression on the maxillary dorso-anteriorly to the orbit is not pronounced, which indicates that the levator labii superioris proprius muscle probably was not well developed. There are a number of other differences of proportions in the two species.

The auditory plate and the basicranial region of this specimen are of special interest because the sutures are so clearly shown. The auditory plate is of greater antero-posterior length, and the dorso-anterior margin does not descend as sharply as in *A. gregoryi*. In *A. gregoryi*

MEASUREMENTS OF THE SKULL

	mm.
Exoccipital condyle to anterior border of canine.	37.4
Height of occiput, basioccipital to top of sagittal crest. . . .	11.6
Height of skull above alveolus of M^1	12.6
Front of antorbital ridge to occipital condyle.	33.0
Front of antorbital ridge to front of enlarged incisor.	8.7
Greatest width across maxillaries above posterior of canines. .	8.0
Width across maxillaries on postero-exterior of Ms^1 alveoli. . .	13.8
Length of tooth row, anterior of C to posterior of M^3 on alveoli.	13.8
Anterior of C to P^1 , inclusive, on alveoli.	8.6
Length of C on alveolus.	2.2
Greatest width of C.	1.5
Greatest length of P^1	2.9
Width of P^1 at center of crown on alveolus.	3.1
Greatest length of M^1	2.6
Width of M^1 at center of crown on alveolus.	3.7
Greatest length of M^2	1.9
Width of M^2 at center of crown on alveolus.	3.4
Greatest length of M^3	1.0
Greatest width of M^3	3.0
Glenoid cavity to occipital condyle.	14.6

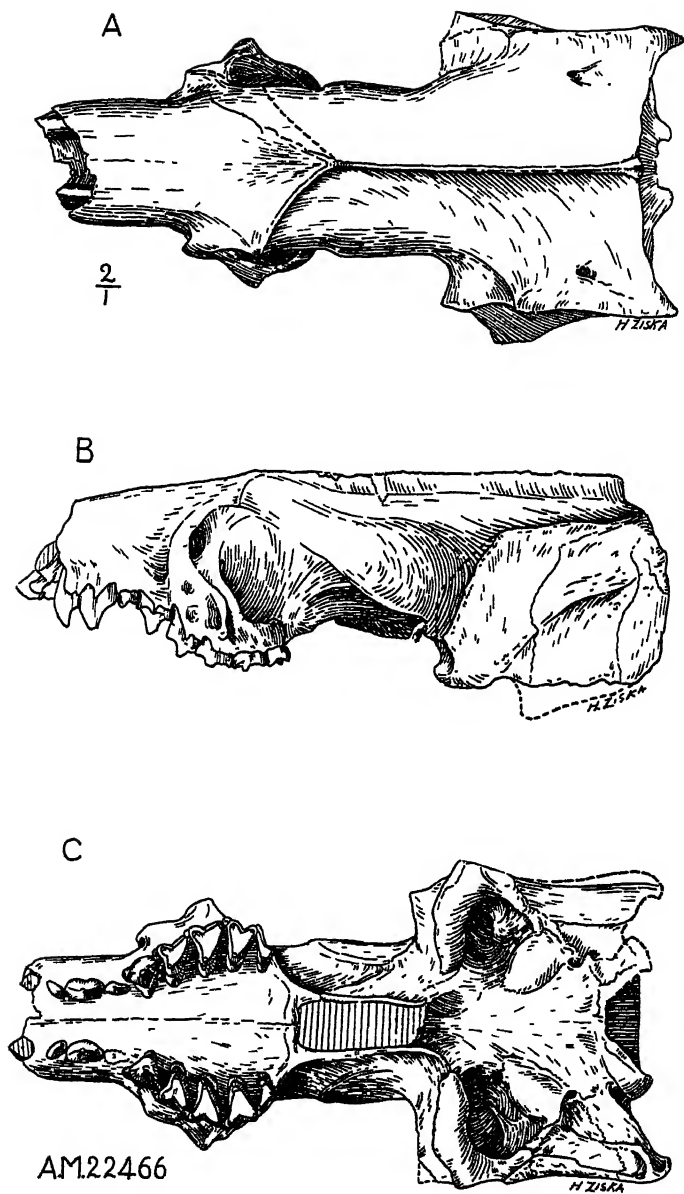


Fig. 2. *Apternodus brevirostris*, new species. A.M. 22466. A, dorsal; B, lateral; C, palatal views of the skull. Twice natural size.

this plate presents only one discernible suture. It is situated just in front of the posterior margin and I considered it to be between the squamosal and the mastoid portion of the periotic. It is now clear that this is the suture between the posterior border of the mastoid portion of the periotic and the exoccipital, the latter forming the posterior margin of the auditory plate. Farther forward on the plate is another suture which is between the squamosal and the mastoid portion of the periotic. The dorsal extensions of both sutures are obscure. It is now established that the mastoid does not enter into the formation of the lambdoid crest as I had previously supposed.

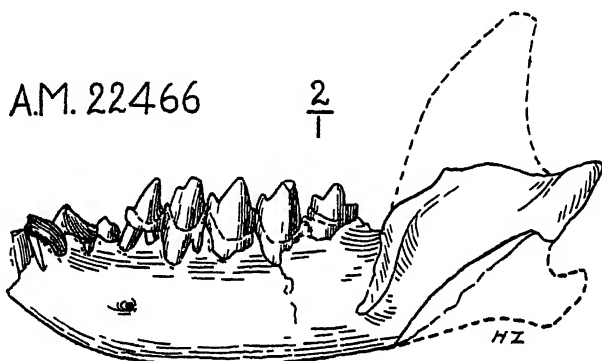


Fig. 3. *Apternodus brevirostris*, new species. A.M. 22466. External view of left ramus of the lower jaw. Twice natural size.

MANDIBLE

Only the left lower jaw is preserved. The ascending ramus and the angle are lacking. The horizontal ramus is massively constructed and is noticeably heavier and deeper in the symphyseal region than is that of *A. gregoryi*. The mandibular condyle is heavier though less broadly expanded than in *A. gregoryi*. In other respects the two specimens are much the same.

MEASUREMENTS OF THE JAW

	mm.
Posterior of I_1 (on alveolus) to condyle .	25.3
Posterior of I_1 to M_3 on alveoli. .	14.2
M_{1-3} on alveoli. . .	6.3
M_{2-3} on alveoli. . .	4.0
Depth of jaw under center of M_2 (internal). .	6.4
Posterior of M_3 to foramen mandibulare. .	5.6
Width of condyle.	6.2

CONCLUSION

In 1910, Dr. Matthew suggested the subfamily name *Apternodontinae* to include the genus *Apternodus*. He also suggested that this subfamily be included in the family Tenrecidae (Centetidae). In my recent paper I proposed that the Solenodontidae should include this subfamily. That *Solenodon* is the living form which is most nearly related to *Apternodus* is, I believe, unquestionable. This conclusion may be drawn from the fact that *Apternodus* does not possess a single character common to any other zalambdodont which is not also common to *Solenodon*, and I have previously listed a large number of characters that are distinctive only of these two genera. The question which remains is whether or not *Apternodus*, because of its specializations, should be removed from the family Solenodontidae and placed in a separate family, the Apternodontidae. To be sure, the development of the auditory plates in *Apternodus* is a striking specialization. This character, however, probably was primarily coincident with a fossorial habitus. Specialization of the incisor teeth is more generally the rule rather than the exception, not only among zalambdodonts but among all of the Insectivora. It is not surprising, therefore, that the incisors of *Apternodus* are specialized. What is outstanding, however, is that this form has selected the reduction of I_2 and the probable loss of I^2 . Despite the fact that *Apternodus* is distinctive in these two characters, I am of the opinion that since, in the less variable structures of the skull, it is so strikingly similar to *Solenodon* it should for the present at least retain its position under the family Solenodontidae.

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THE DISTRIBUTION OF ROTIFERA ON MOUNT DESERT ISLAND. PART IV¹

NEW NOTOMMATIDAE OF THE GENUS *CEPHALODELLA*

BY FRANK J. MYERS

Dixon-Nuttall and Freeman (1903), in their revision of the genus *Diaschiza* = *Cephalodella* Bory de St. Vincent, described fourteen species, one of which was new. Since then fifty-two additional species have been recorded and the end is not in sight. The genus is evidently destined to become a very large one, as it already contains more species than any other among the plioimate rotifers. This is partially accounted for by their small size as a group, and the fact that the majority are found in acid water, among submerged aquatic vegetation, especially *Sphagnum*, an association not very common in nature and one that has not been explored intensively, except by a few investigators who have concentrated on the group.

Although the genus now includes a great many species, they are readily distinguished by easily ascertained differences, the most important of which are as follows: the relative size of the animal, the position of the eyespot, or eyespots, if any, the relative length and shape of the toes; and the shape of the manubria, whether straight, recurved, decurved, clubbed or crutched at the tips.

As the internal anatomy of the various species is very constant, only the characters differing from the normal will be mentioned in order to avoid unnecessary repetition.

The species herein described were collected in acid water, marsh and littoral associations in various locations on the Island, during the springs and summers of 1921 to 1932 inclusive.

The fourteen new species described in this paper are as follows:

Cephalodella doryphora
Cephalodella tachyphora
Cephalodella mucosa
Cephalodella euknema
Cephalodella dorystoma
Cephalodella mira
Cephalodella eurynota

Cephalodella ablusa
Cephalodella astricta
Cephalodella lepida
Cephalodella poitera
Cephalodella akroboles
Cephalodella praelonga
Cephalodella abstrusa

¹The preceding parts of this article appeared in American Museum Novitates as follows: Part I (not numbered) in No. 494, Sept. 28, 1931; part II in No. 659, Sept. 15, 1933; part III in No. 680, Sept. 15, 1933.

CORRECTIONS AND OMISSIONS IN PARTS I TO III
OF THIS SERIES OF ARTICLES

Part I, p. 6, and part III, pp. 1, 10, and 11: for *Eothina* read *Eothinia* in every case.

Parts II and III omitted to record that the following names of new species therein described had been previously published as *nomina nuda* in Remane, 1929-1933, Lief. 4 (1933), as follows:

<i>Notommata endoxa</i>	on page 551
“ <i>aethis</i>	“ “ “
“ <i>avena</i>	“ “ “
“ <i>apochaeta</i>	“ “ “
“ <i>prodota</i>	“ “ “
“ <i>fasciola</i>	“ “ “
<i>Proales phaeopsis</i> (as <i>phacopsis</i>)	“ “ 542
“ <i>adenodis</i>	“ “ “
“ <i>ornata</i>	“ “ “
“ <i>granulosa</i>	“ “ “
“ <i>bemata</i>	“ “ “
“ <i>gladia</i>	“ “ “
“ <i>macrura</i>	“ “ “
<i>Lindia caerulea</i>	“ “ 574
“ <i>ecela</i>	“ “ “
<i>Proalinopsis gracilis</i>	“ “ 544
“ <i>phacus</i>	“ “ “
“ <i>selene</i>	“ “ “

ORDER PLOIMA

Family Notommatidae

***Cephalodella doryphora*, new species**

Figure 1

Cephalodella doryphora REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is very short and stout. The head is large and obliquely truncate anteriorly. The neck is sharply marked off by a constriction. The abdomen is gibbous dorsally, deepest above the lumbar region, whence it falls away abruptly to the very short foot. The lorica is firm and the plates are very distinct. The toes are blade-shaped, acutely pointed and slightly decurved, diminishing gradually from the base to the tips.

The corona is oblique and strongly convex; the lips project in the form of a prominent cuticular beak.

The mastax is huge and of the specialized virgate type peculiar to the genus. The fulcrum is very long, stout and expanded posteriorly; the manubria are slender, recurved and semicircular, the slightly swollen tips being situated just under the eyespot. The epipharynx is long and acicular; it helps in perforating the integument of other rotifers on which this species feeds. However, it cannot be thrust out of the mouth opening, by a rocking of the mastax in a transverse plane, as in *Dorystoma caudata* (Bilfinger). The action of the mastax as a whole is quite normal.

The gastric glands and ovary are small.

The ganglion is long and carries a large eyespot, somewhat ventrally placed, at its posterior end.

Total length, 105μ ; toes, 15μ .

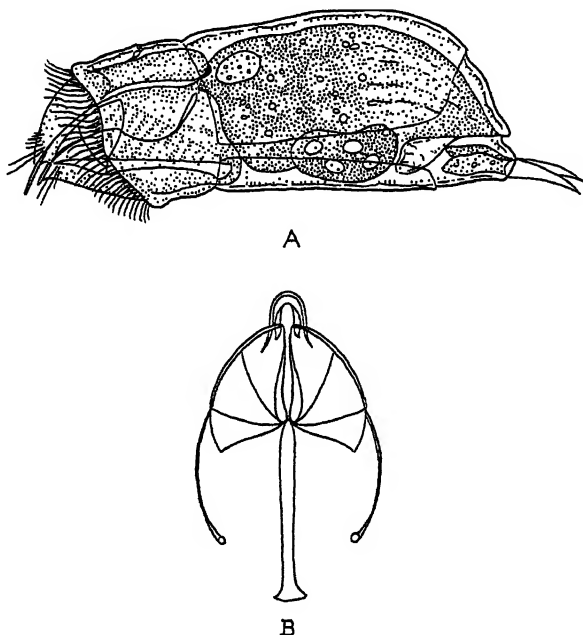


Fig. 1. *Cephalodella doryphora*, new species.
A, lateral view; B, trophi, ventral view.

Cephalodella doryphora was common during several summers in the Witch Hole and Aunt Bettie Pond, among submerged *Sphagnum*. It has also been collected sparingly in Atlantic County, New Jersey. The species bears a certain resemblance to *Cephalodella physalis* Myers, but is readily distinguished from it by the much smaller size, the very prominent beak, the trophi, and relatively shorter toes.

***Cephalodella tachyphora*, new species**

Figure 2

Cephalodella tachyphora REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is short and stout. The head is large and slightly deflexed. The neck is sharply set off by a constriction. The abdomen is evenly arched dorsally; its greatest depth is near mid-length. The lorica is firm and the plates distinctly marked. The foot is short and overhung by a minute tail. The toes are very long, stout and

wide apart at the base, whence they taper gradually to very slender acute tips. The foot glands are stout and pyriform.

The corona is oblique and strongly convex; the lips protrude as two prominent cuticular processes.

The mastax is large. The fulcrum is very long, stout and abruptly expanded posteriorly. The manubria are reduced to very short slender rods, curving upward in the form of a semicircle. The epipharynx is slender and acicular; it helps in piercing the integument of other rotifers on which this species feeds.

The gastric glands are pyriform and the ovary is small.

The ganglion is long and carries an eyespot, somewhat dorsally placed, attached to its posterior end.

Total length, 130μ ; toes, 45μ .

Cephalodella tachyphora was common among decaying *Utricularia* in the northeast arm of the Barcelona, during the summer of 1925. It

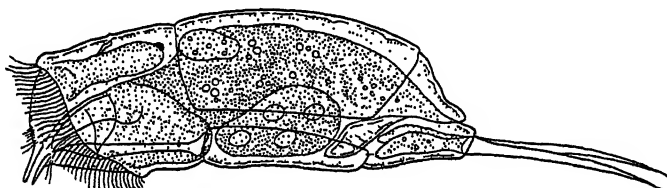


Fig. 2. *Cephalodella tachyphora*, new species.
Lateral view.

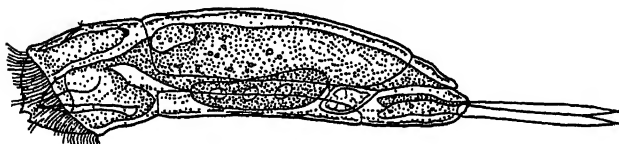


Fig. 3. *Cephalodella mucosa*, new species.
Lateral view.

has since been collected in abundance among marginal *Sphagnum* in Indian Cabin Creek, Atlantic County, New Jersey. Its movements are very fast and active. The shape of the body and the toes suggest *Cephalodella galbina* Myers. The position of the eyespot on the ganglion and the very prominent cuticular beak readily distinguish it from that species.

Cephalodella mucosa, new species

Figure 3

The body is prismatic and elongate. The head is somewhat deflexed and separated from the trunk by a well-marked neck constriction. The abdomen tapers gradually, being arched dorsally and somewhat concave ventrally. The lorica is firm and the plates are well defined. The foot is short and the tail is small. The toes are very long, blade-shaped and lanceolate. The foot glands are long and slender.

The corona is obliquely convex and has small projecting lips.

The mastax is normal in size. The fulcrum is long and somewhat expanded posteriorly; the manubria are very short, slender and abruptly recurved.

The ganglion is long, and carries a round eyespot attached to its posterior end.

Total length, 125 μ ; toes, 30 μ .

Cephalodella mucosa is well distributed throughout the Island in the smaller bodies of water, such as pools in which there is an abundance of decaying *Sphagnum*. It is very rapid and active in its movements, and has no near relative in the genus.

Cephalodella euknema, new species

Figure 4

Cephalodella euknema REMANE, 1929-1933, p. 566 (*nomen nudum*).

The body is elongate, slender and cylindric. The head is moderately large and obliquely truncate anteriorly. The neck is well marked. The abdomen is nearly parallel-sided; it increases in depth but little toward the posterior portion. The lorica is quite flexible, but the plates are well defined. The foot is short and the tail is minute. The toes are very long and slender; they are slightly swollen near mid-length, whence they taper gradually to abrupt upturned, very slender tips.

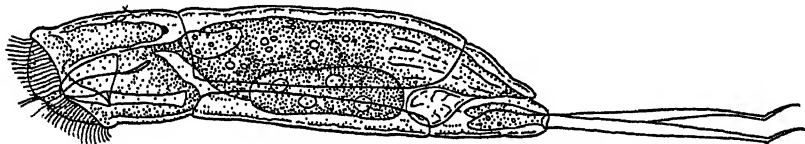


Fig. 4. *Cephalodella euknema*, new species.

Lateral view.

The corona is oblique and convex; the lips do not project.

The mastax is large. The fulcrum is very stout and expanded posteriorly; the manubria are very slender and recurved.

The ganglion is long and carries a small round eyespot attached to its posterior end.

Total length, 225 μ ; toes, 75 μ .

Cephalodella euknema was collected near the outlet of Ripple Pond, among decaying meadow grass which had been washed into a small eddy. It bears a superficial resemblance to *Cephalodella tenuiseta* (Burn). The presence of a cervical eyespot, the much smaller size, and the shape of the toes readily distinguish it from that species.

Cephalodella dorystoma, new species

Figure 5

Cephalodella dorystoma REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is elongate and tapering. The head is relatively small and obliquely truncate anteriorly. The abdomen is cylindrical and evenly arched dorsally. The

lorica is quite firm and the plates are well defined. The toes are short, acute, and decurved. The foot glands are very large and pyriform.

The corona is oblique and strongly convex; the lips do not project.

The mastax is relatively small. The fulcrum is slightly expanded posteriorly; the manubria are straight, slender rods, somewhat expanded at the tips. The gastric glands are huge, being nearly equal to the mastax in size.

The ganglion is long and carries a small, clear, refringent vacuole near the posterior end.

Total length, 170μ ; toes, 20μ .

Cephalodella dorystoma was collected during the summer of 1924 among vegetable detritus in Ripple Pond. There were no submerged aquatics, and collections were made in a quiet spot, not more than one square yard in area, where small pieces of detached and decaying meadow

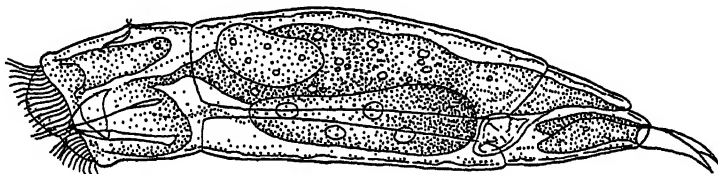


Fig. 5. *Cephalodella dorystoma*, new species.
Lateral view.

grass had accumulated. The rotifer has not been found again, although the location has been visited several times since.

The tendency among certain species of rotifers to disappear for longer or shorter intervals of time is well known. Up until 1929, *Cephalodella melia* Myers was one of the commonest species to be found in Atlantic County, New Jersey; it disappeared suddenly and has not been found since. *Tetrasiphon hydrochora* Ehrenberg was common in certain locations, among filamentous algae and desmids, in Atlantic County; it suddenly disappeared and none was found until three years had elapsed, when it reappeared in abundance.

Cephalodella dorystoma has no near relative. The clear eyespot, together with its position on the ganglion, the relatively very small mastax, the huge gastric glands, and the shape of the toes are enough to distinguish it readily from any other species of the genus.

***Cephalodella mira*, new species**

Figure 6

Cephalodella mira REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is parallel-sided and nearly cylindrical throughout. The head is relatively small, and the neck is not well defined. The lorica is very thin and flexible, and

the plates are indistinct. The foot is robust and conical; the toes are short, blade-shaped, slightly recurved, ending in acute tips. The foot glands are large and pyriform.

The corona is convex and without projecting lips.

The mastax is large and somewhat aberrant. All the parts of the trophi are very slender. The fulcrum is long, slender and parallel-sided. The manubria are reduced to very thin rods that are slightly expanded at the tips. As the mastax functions

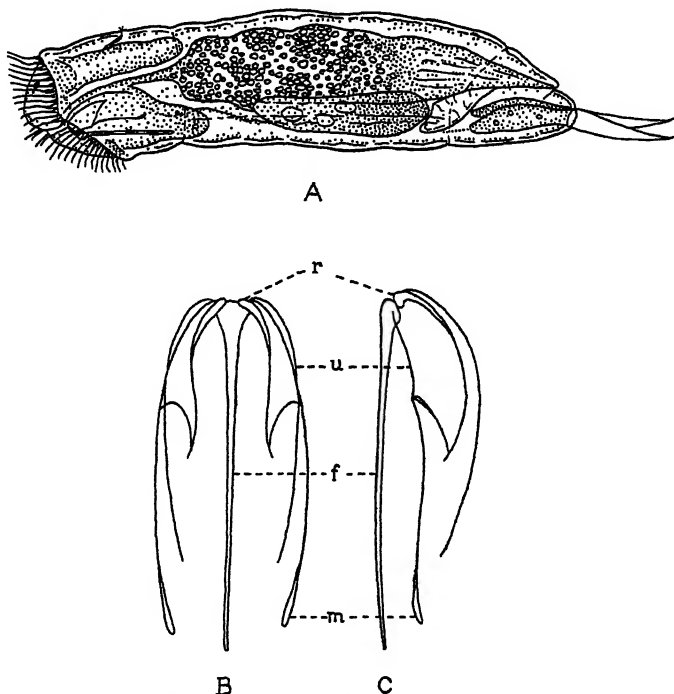


Fig. 6. *Cephalodella mira*, new species.

A, lateral view. B, trophi, ventral view. C, lateral view: *r*, ramus; *u*, uncus; *f*, fulcrum; *m*, manubrium.

entirely by suction, the horizontal action of the rami has been lost; they project backward and help form the domelike cavity that supports the wall of the mastax during pumping action. The unci are evanescent. There are a large pair of salivary glands attached to the lateral lobes of the mastax.

No gastric glands were observed. Digestion is probably intracellular, as the syncytial cells of the stomach walls are crowded with globular, greenish, chlorella-like inclusions.

The ganglion is very long. There are two small frontal eyespots.

Total length, 145 μ ; toes, 22 μ ; trophi, 30 μ .

Cephalodella mira is well distributed on the Island. It has frequently been collected in Atlantic County, New Jersey and Vilas County, Wisconsin. The trophi bear a certain resemblance to those of *Cephalodella megalcephalia* (Glasscott) and *Cephalodella pheloma* Myers. This species is readily distinguished from the above two by the presence of frontal eyespots, the large salivary glands, and the minor differences in the trophi.

***Cephalodella eurynota*, new species**

Figure 7

Cephalodella eurynota REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is cylindric, fusiform and gibbous dorsally. The head is rather small, slightly deflexed and obliquely truncate anteriorly. The lorica is rigid and the plates are well defined. The toes are very long, slender and decurved; they taper gradually from the base to very slender tips. The foot glands are large and stout.

The corona is oblique, strongly convex, and has prominent projecting lips.

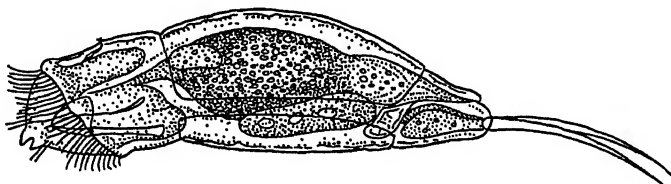


Fig. 7. *Cephalodella eurynota*, new species.

Lateral view.

The mastax is large. The fulcrum is straight and expanded posteriorly; the manubria are slightly recurved.

The ganglion is long, and there is no eyespot.

Total length, 105 μ ; toe, 30 μ .

Cephalodella eurynota was collected during several summers in the Witch Hole, among submerged *Sphagnum*. It has also been found sparingly in Atlantic County, New Jersey. The curved fusiform body, the long, slender, decurved toes, the absence of an eyespot, together with the huge foot glands, serve to distinguish this from any other species of the genus.

***Cephalodella ablusa*, new species**

Figure 8

Cephalodella ablusa REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is extremely elongate, cylindric, very slender and laterally compressed. The head is relatively short and the neck indistinctly marked. The abdomen is almost parallel-sided throughout its entire length. The lorica is soft and flexible, the plates being hardly apparent. The toes are robust and decurved laterally. Some

distance from the base they diminish abruptly and end in extremely slender, drawn-out tips. The foot glands are large and elongate.

The corona is oblique, strongly convex and without projecting lips.

The mastax has a pair of salivary glands attached to the lateral lobes. The fulcrum is fairly stout and enlarged posteriorly. The manubria are slender, recurved and slightly swollen near the tips. The gastric glands are enormous and pyriform in shape, the obtuse ends being directed forward.

The ganglion is normal, and there is no eyespot.

Total length, 148μ ; toes, 25μ .

Cephalodella ablusa was collected among submerged *Fontinalis* in Round Pond during the summer of 1927. It is obscurely related to *Cephalodella elongata* Myers, from which it differs by the absence of eyespots, the larger gastric glands, the presence of salivary glands, and the toes.

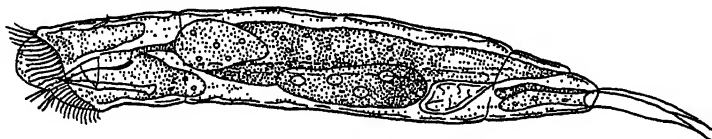


Fig. 8. *Cephalodella ablusa*, new species.
Lateral view.

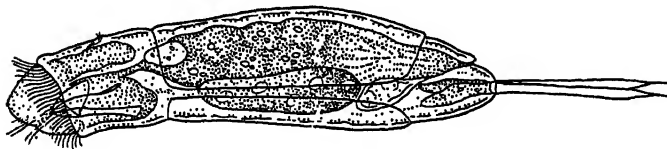


Fig. 9. *Cephalodella astricta*, new species.
Lateral view.

Cephalodella astricta, new species

Figure 9

Cephalodella astricta REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is elongate and slightly gibbous dorsally from the lateral view; it is much compressed dorsoventrally, being nearly twice as broad as it is in depth. The head is relatively small. The lorica is thin and flexible, but the plates are well defined. The foot is very short and stout. The toes are long, slender, and lanceolate from the lateral view; dorsally, they are parallel-sided and the tips are slightly outcurved.

The corona is strongly convex, and without projecting lips.

The mastax is relatively small. The fulcrum is stout and expanded posteriorly; the manubria are very slender, slightly recurved and expanded near the tips.

The ganglion is long, and there is no eyespot.

Total length, 155μ ; toes, 35μ .

Cephalodella astricta was collected in Half Moon Pond during the summer of 1928. Its movements are extremely fast and active. The compressed body and the long lanceolate toes distinguish this from any other species of the genus.

***Cephalodella lepida*, new species**

Figure 10

Cephalodella lepida REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is slender, cylindric and almost parallel-sided. The head is somewhat deflexed and oblique anteriorly. The head is set off by a well-marked neck constriction. The lorica is quite flexible, but the plates are sharply defined. The foot is small and the tail is minute. The toes are long, slender, blade-shaped and recurved; they taper gradually and end in acutely drawn out tips.

The corona is oblique, and the lips do not project as a beak.

The mastax carries a pair of salivary glands attached to the lateral lobes. The fulcrum is stout and reduced in the middle portion; the manubria are expanded in

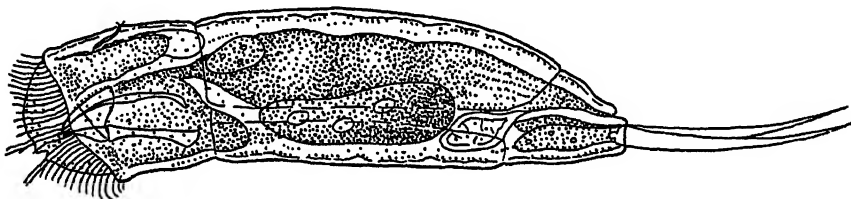


Fig. 10. *Cephalodella lepida*, new species.

Lateral view.

the middle and end in slightly swollen, decurved tips. The gastric glands are small and pigmented a yellowish red.

There is a clear, round retrocerebral sac curving over posterior portion of the ganglion, the duct of which can be traced some distance forward. There is no eyespot.

Total length, 225 μ ; toes, 52 μ .

Cephalodella lepida is evenly distributed throughout the Island; it is especially abundant at times in the presence of decaying *Sphagnum* which has turned grayish. The species has been collected also in Atlantic County, New Jersey, under similar conditions. The presence of a retrocerebral sac, together with the remnants of the duct, and the differences in the trophi and toes, readily distinguish this species from *Cephalodella hyalina* Myers which it resembles superficially.

***Cephalodella poitera*, new species**

Figure 11

Cephalodella poitera REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is short and stout. The head is large and obliquely truncate anteriorly. The neck is well marked, and the abdomen is evenly arched. The lorica is firm and the

plates are well defined. The foot is short and stout. The toes are blade-shaped, decurved, and taper from a broad base to very acute tips.

The corona is convex, and the lips project as a small beak.

The mastax is very large. The fulcrum is long and abruptly expanded posteriorly. The manubria are stout, expanded in the middle portion, and crutched at the tips. The gastric glands are small and reniform.

The ganglion is long; there is no eyespot.

Total length, 120μ ; toes, 18μ .

Cephalodella poitera was collected in the Northeast Branch of the Barcelona, where it occurred at certain times in large numbers. Its movements are very rapid and restless. The species bears a superficial resemblance to *Cephalodella physalis* Myers and *Cephalodella globata* (Gosse), but differs from them by the absence of an eyespot, the elements of the trophi, and the shape of the toes.

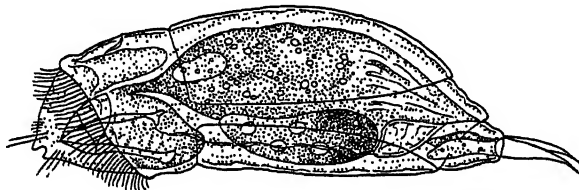


Fig. 11. *Cephalodella poitera*, new species.
Lateral view.

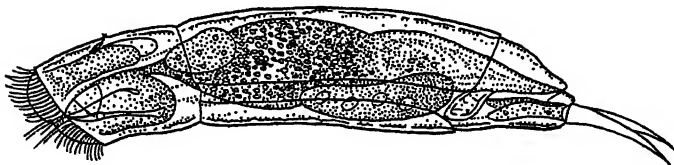


Fig. 12. *Cephalodella akrobes*, new species.
Lateral view.

***Cephalodella akrobes*, new species**

Figure 12

Cephalodella akrobes REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is elongate, slender, and slightly arched. The head segment is protected by a distinct loricum which contracts into definite dorsal folds when the corona is retracted. The neck is well marked, and the abdomen is laterally compressed, slightly arched dorsally and of the same depth throughout. The plates are sharply defined and the lateral clefts are wide apart. The foot is short and the tail is very small. The toes taper gradually to very fine, acute tips; they are wide apart at the base.

The mastax is relatively small. The fulcrum is straight and expanded posteriorly; the manubria are slender and abruptly decurved near the tips.

The ganglion is long and saccate; at its posterior end there is a clear retrocerebral sac, the duct of which can be traced a short distance forward. The gastric glands are very large and pyriform. There is no eyespot.

Total length, 120 μ ; toes, 20 μ .

Cephalodella akroboles was collected among decaying *Utricularia* in the Barcelona. It is also well distributed in Atlantic County, New Jersey. This species, together with *Cephalodella praelonga* Myers, and *Cephalodella strepta* Myers, form a group within the genus all of which have very stiff inflexible loricae with the head-sheath falling into distinct folds on contraction. They are all slender and elongate, their manubria are bacillar and expanded posteriorly, their toes are long, and they have no eyespots, thus forming a closely related group within the genus.

***Cephalodella praelonga*, new species**

Figure 13

Cephalodella praelonga REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is extremely elongate and slender. The head is relatively short and the integument is stiffened into a distinct lorica. When the corona is fully retracted, the

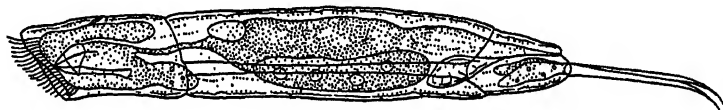


Fig. 13. *Cephalodella praelonga*, new species.

Lateral view.

cuticle falls into several dorsal head folds. The lorica is almost inflexible; the plates are sharply defined, and the lateral clefts are narrow and parallel-sided. The foot is very short. The toes are long, slender, and abruptly decurved distally; they end in fine decurved threadlike tips.

The corona has never been observed extended beyond the opening of the head-sheath. From numerous specimens examined, both living and preserved, it is doubtful if the head ever protrudes beyond the lorica.

The mastax is relatively small and has a pair of salivary glands attached to the lateral lobes. The fulcrum is straight and slightly expanded posteriorly; the manubria are very short, bacillar and slightly decurved.

The esophagus is very long and slender. The gastric glands are small and oval. The ganglion is normal, and there is no eyespot.

Total length, 157 μ ; toes, 34 μ .

Cephalodella praelonga was found in pools, among submerged *Sphagnum*, on Pond Heath, during the summer of 1930. It belongs to that group within the genus that is characterized by having the lorica of the head stiffened so as to form a sheath that falls into definite folds when the corona is retracted. The long slender toes, sharply decurved

near the tips, the presence of salivary glands, and the peculiar head opening readily distinguish this from the other members of the group.

***Cephalodella abstrusa*, new species**

Figure 14

Cephalodella abstrusa REMANE, 1929-1933, p. 556 (*nomen nudum*).

The body is fairly stout, cylindric, evenly arched dorsally and nearly straight ventrally. The head is small and obliquely truncate anteriorly. The neck is marked off by a sharp constriction. While the integument is quite flexible, the plates are well defined. The toes are short, straight and conical, ending in blunt tips.

The corona is oblique and strongly convex, and the lips do not project.

The mastax is fairly large. The fulcrum is long and straight; the manubria are stout, slightly longer than the fulcrum, and expanded posteriorly.

The gastric glands are peculiar; they are large and oval, and the central portion is occupied by a refringent vacuole, which is present in every individual. The ovary is large, and the bladder is small.

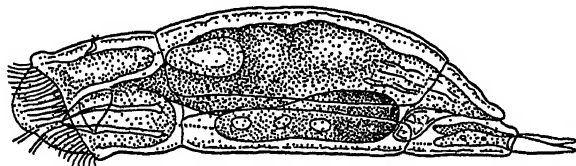


Fig. 14. *Cephalodella abstrusa*, new species.
Lateral view.

The ganglion is long, and there is no eyespot.

Total length, 104 μ ; toes, 12 μ .

Cephalodella abstrusa was very abundant during several summers in plankton collections from Upper Hadlock Lake. The species is parasitic in the alga *Coelosphaerium kuetzingianum* Naegeli.

It has been observed that some rotifers, after having been in captivity for a certain time, become subjected to a pathological condition of the gastric glands (Bryce, 1903, *op. cit.*, p. 528). One or more of the nuclei enlarge to such an extent that the whole gland appears like one clear vacuole. This is not the case with *Cephalodella abstrusa*. The animals were collected in their natural habitat, during several summers, and examined within the hour. The ecological conditions of Upper Hadlock Lake were normal and the oxygen content of the water was ample. This rotifer is a true parasite; nearly every cenobia of *Coelosphaerium* was infested, in many cases with six or more individuals, together with numerous eggs in the course of development.

The vacuolated gastric glands, the elements of the trophi, the short toes with blunt tips, and the parasitism of this species, readily distinguish it from any other of the genus.

New species of other genera of rotatoria will be described in Part V of the 'Distribution of Rotifera on Mount Desert Island,' and will appear in American Museum Novitates.

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THE DISTRIBUTION OF ROTIFERA ON MOUNT DESERT
ISLAND. PART V¹A NEW SPECIES OF SYNCHAETIDAE AND NEW SPECIES OF AS-
PLANCHNIDAE, TRICHOCERCIDAE, AND BRACHIONIDAE

BY FRANK J. MYERS

The previous parts of the present work were devoted to new species belonging to the family Notommatidae. In this part a number of new and distinctive species, belonging to several families, are figured and described, as it is felt that these rotifers should be placed on record. Most of the species have been known for a number of years, having been originally found in Atlantic County, New Jersey, and later found again on Mount Desert Island. The rotatorian fauna of southern New Jersey, northern Wisconsin, and Mt. Desert Island is closely approximate.

New species described in this paper are as follows:

Asplanchnidae
Asplanchnopus dahlgreni
Synchaetidae
Ploesoma formosum
Trichocercidae
Trichocerca platessa
Trichocerca ornata
Brachionidae
Macrochaetus multispinosus
Macrochaetus longipes
Colurella logima
Colurella aemula

ORDER PLOIMA

Family Asplanchnidae

Asplanchnopus dahlgreni, new species

Figure 1

The body is stout, being very gibbous dorsally and nearly straight ventrally. The posterior portion is separated from the head by a slight constriction which is faintly striated. There are three humps: one dorsal which is directed forward, and two lateral which are directed backward.

¹The preceding parts of this article appeared in American Museum Novitates as follows: part I (not numbered) in No. 494, Sept. 28, 1931; part II in No. 659, Sept. 15, 1933; part III in No. 660, Sept. 15, 1933; part IV in No. 699.

The corona is reduced to a circumapical band of long locomotor cilia, interrupted by a dorsal and a ventral gap and, laterally, by two small protuberances each bearing a red pigment-spot. There are a pair of prominent tubules on the apical area from which emerge tufts of sensory setae. The foot is about one-fifth the length of the

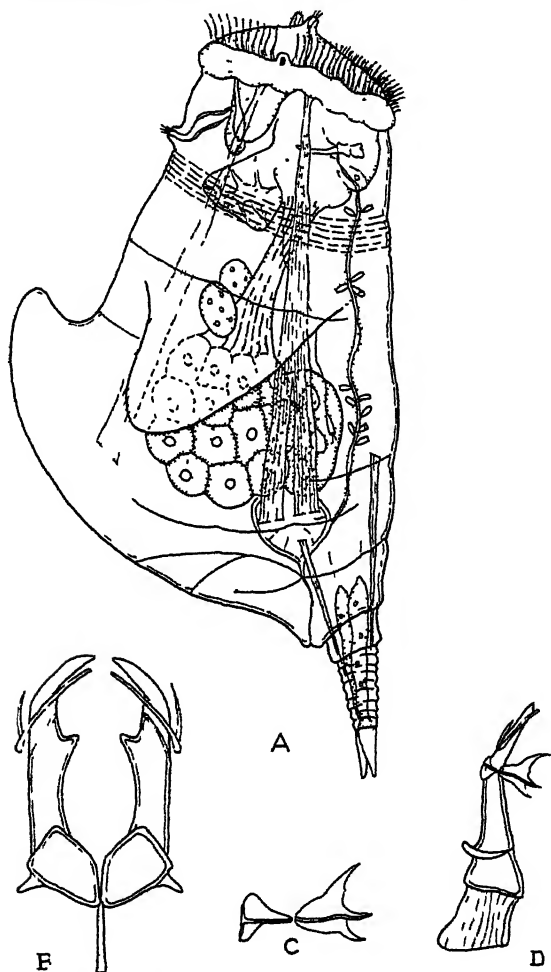


Fig. 1. *Asplanchnopus dahlgreni*, new species.

A, lateral view; B, incus, ventral view; C, uncus and manubrium; D, trophi, lateral view.

body and consists of two joints. The basal joint is short and stout; the terminal joint is relatively long and transversely wrinkled. The toes are short, triangular, and laterally compressed.

The dorsal antenna is prominent, and two nerve fibers pass from it to the ganglion. The lateral antennae are situated on each side of the body opposite the ovary.

The mastax is of the incudate type. The fulcrum is reduced to a quadrangular plate which is nearly as long as it is broad. Each ramus carries a prominent triangular tooth on the inner margin, and a strong apophysis near the base of the external edge. The mallei are much reduced. Each uncus has one rudimentary tooth attached to a weblike plate which articulates with the trifid manubrium. There is a slender curved rod, superimposed on the extremity of each ramus, that corresponds to a similar structure in the trophi of *Harringia eupodia* (Gosse), (De Beauchamp, 1912, *op. cit.*, p. 328). In this case, these rods are probably remnants of the dorsal tooth of the uncus which have become completely detached.

A stout esophagus leads to the stomach which is thick-walled and has prominent cells for the absorption of the products of digestion. The ovary is small and round. There are twelve flame cells, attached to the nephridial tubes, on each side of the intestinal tract: seven at the level of the ovary, three just below the gastric glands, and two just posterior to the mastax. The bladder is normal. The foot glands are long and extend for some distance into the body cavity.

The retrocerebral sac is small and clear; the subcerebral glands are slightly shorter than the sac. There is no eyespot attached to the ganglion.

Average length, 550 μ ; foot, 72 μ ; toes, 35 μ .

HABITAT.—Littoral region of acid-water lakes and ponds.

Asplanchnopus dahlgreni is evenly distributed, although never abundant, throughout the Island. It has also been collected in Atlantic County, New Jersey. So far as is known this species is oviparous, at least nothing has been observed that would indicate the contrary. The humpless form has not been seen and it is doubtful whether this rotifer is dimorphic. When the animal is fully extended and actively moving about, there are three deep crevices in the dorsal integument. The humps are only apparent when the rotifer contracts, at which time they are evaginated by hydrostatic pressure.¹

The peculiar "punch-like" shape of the dorsal hump, directed forward, the absence of a cervical eyespot, the number and arrangement of the flame cells, the long wrinkled, terminal foot joint, the round ovary, and the differences in the trophi readily distinguish this from the remaining species of the genus.

The principal differences between the species of *Asplanchnopus* are:

Asplanchnopus multiceps (Schrank).—No humps; double dorsal antenna; one cervical and two accessory frontal eyespots; ovary horseshoe-shaped; foot very short; fifty or more flame cells on each side; rami without denticulation on inner margins; viviparous.

Asplanchnopus hyalinus Harring.—No humps; double dorsal antenna; one cervical and two frontal accessory eyespots; ovary ribbon-shaped; foot long, telescopically jointed; eight flame cells on each side; rami without denticulation on inner margins; oviparous.

¹The figure shows this rotifer fully extended, with the humps everted, in order to save a duplication of figures.

Asplanch-nopus dahlgreni Myers (new species).—Three humps; single dorsal antenna; two coronal eyespots, cervical eyespot wanting; ovary round; foot long, terminal joint transversely wrinkled; rami with one stout tooth on each inner margin; oviparous.

Family Synchaetidae

Ploesoma formosum, new species

Figures, 2, 3, 4

The body is roughly quadrangular from the lateral view; it is rhomboidal, truncate anteriorly, and pointed posteriorly from the dorsal view. The adult females are invariably pigmented a deep yellowish-red. The lorica is divided into definite areas bounded by ridges, and the spaces between the ridges are ornamented by small

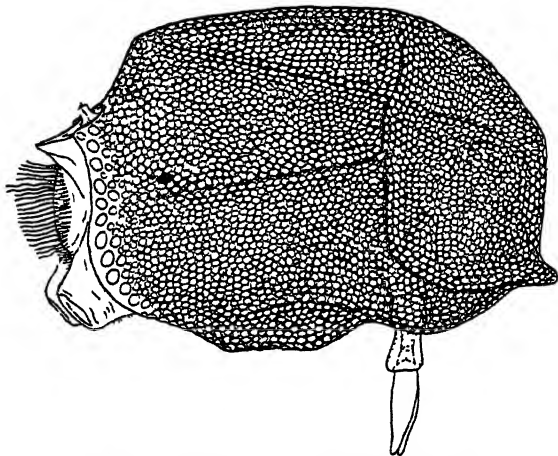


Fig. 2. *Ploesoma formosum*, new species.
Lateral view.

fossettes which are large and widely spaced near the frontal margin. The anterior dorsal margin is undulate and, in the middle, there is a deep, sub-square sinus, for the emergence of the dorsal antenna. The ventral anterior margin is a deeply excised oval arc. The foot is ventrally placed, and is composed of two joints which emerge through an ovate opening of the lorica, situated just back of the middle of the venter. The toes are stout, blade-shaped and lanceolate.

The corona is composed of a supraoral, triangular buccal plate of short, densely set cilia, and a circumapical band reduced to two lateral arcs of strong locomotor cilia. On each side of the mouth there is a retractile, cuticular boss which is invaginated in the central portion.

The lateral antennae emerge from a papillose prominence, situated at the junction of the median lateral ridge of the lorica with the perpendicular ridge. The dorsal antenna is prominent and tubular. The mastax is of a modified virgate type and the trophi are asymmetric. The fulcrum is long, slightly expanded and serrate posteriorly.

The rami are roughly triangular, the left being larger than the right; there are no teeth or other denticulation on their inner margins. Near mid-length they are bent at a right angle to the fulcrum. The left uncus has a slender preuncal tooth followed by a long, stout tooth clubbed near the tip; this is followed by eight slender accessory teeth. The right uncus has a stout ventral tooth clubbed near the tip and is followed by six long, slender accessories. The middle branch of the left manubrium is long and stout, the distal portion being strongly incurved; the middle branch of the right manubrium is short and stout. The lamellar basal elements of the manubria are large and of irregular shape.

The gastric glands are large, oblong and pigmented a dark red. The bladder and ovary are normal.

Near the posterior end of the ganglion, on the ventral side, there is a bright red mass which is often broken into several diminishing spots. The retrocerebral sac is

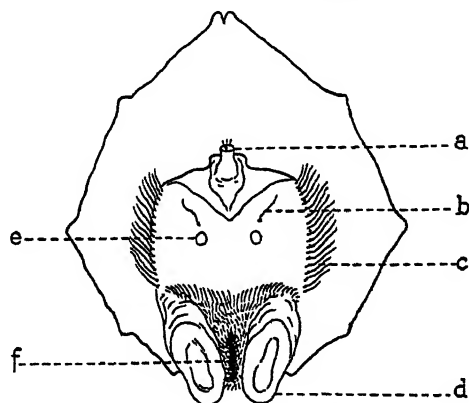


Fig. 3. *Ploesoma formosum*.

Diagrammatic frontal view: a, dorsal antenna; b, sensory seta; c, lateral ciliary arc; d, cuticular boss; e, duct opening; f, mouth.

twice as long as the ganglion and is clear and vacuolate. The retrocerebral duct is very stout and can be traced to the openings, on the apical area, which do not protrude.

Average length of lorica, 215μ ; depth, 150μ ; width, 140μ ; length of toes, 33μ .

HABITAT.—Among and near submerged *Sphagnum* in supra-acid-water associations.

A few specimens of *Ploesoma formosum* were collected in Aunt Bettie Pond during the summer of 1928; it has not been found there since. This is probably due to lowering the surface of the water level in order to facilitate road building around the pond, thus exposing the *Sphagnum* beds among which the rotifer was found. It is fairly common in Atlantic County, New Jersey, in bodies of water the p_H of which is 6.0 or less.

The juxta-buccal protuberances are extraordinary and nothing resembling them is known among the ploimate rotifers. Because of their central evagination, it was thought that these organs might

act as extraneous factors in alimentation, but tests with carmine, on the living animal, showed no particles passing into or out of them. The dorsal antenna protrudes from a soft, cuticular hood. In *Ploesoma triacanthum* (Bergendal), *Ploesoma truncatum* (Levander), and *Ploesoma lenticulare* (Herrick), this hood has become rigid and incorporated with the lorica, which accounts for the position of the dorsal antenna in those species. The lorica is not split ventrally, as in the above-mentioned species; instead, there is an ovate opening from which the foot emerges.

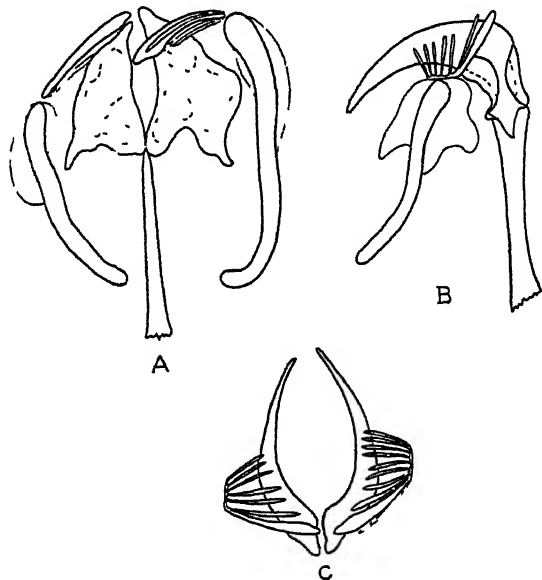


Fig. 4. *Ploesoma formosum*.

A, trophi, ventral view; B, lateral view; C, rami and unci, frontal view.

With the exception of the elevated ridges and the posterior projection, the structure of the lorica resembles that of *Ploesoma hudsoni* (Imhof), which has the same kind of fossettes but much larger. It also differs from the remaining species of the genus by having a telescopically jointed foot, and no digitiform palps on the apical area. There are, however, a pair of long setae situated just above the position of the openings of the retrocerebral duct. The mastax is less specialized than in the other species, and approaches nearer the normal virgate type, as is indicated by the preponderance of the left side over the right, and the bending of the rami at a right angle to the fulcrum, indicating a strong

pumping action. Finally, the entire body is pigmented a bright orange-red, instead of being unpigmented.

While the elements of the corona, the position of the dorsal antenna, the absence of a cleft venter and coronal palps are somewhat aberrant, the relationship is so close to the other species of *Ploesoma* that it is retained in that genus provisionally until more is learned regarding its affinities.

Family Trichocercidae

Trichocerca platessa, new species

Figures 5 and 6

The body is elongate, broadly fusiform dorsally, and greatly depressed. The breadth of the lorica is two-fifths, and the depth only about one-fifth, that of the length. The posterior limit of the head-sheath is indicated by a faint line of demarcation. The anterior margin is without mucrones.¹ There is no sign of a dorsal ridge and the striated area is reduced to a pair of weak muscular bands that compress the anterior portion of the lorica slightly when the head is retracted. The foot opening is small and diagonally placed. The foot is short and projects but slightly. The left toe is about one-half the length of the lorica and nearly straight. The rudimentary right toe is about one-third the length of the left; each toe has three short substyles, of varying length, attached to the base.

The dorsal antenna is tubular and emerges at a point above and halfway between the mastax and the stomach. The lateral antennae are minute tubules from which emerge tufts of sensory setae; they are situated on the dorsal side of the posterior third of the body.

The corona consists of a circumapical band differentiated into a dorsal arc of medium cilia, and two lateral arcs of longer locomotor cilia. Just below the middle of the dorsal arc there is a large, blunt digitiform process, on each side of which is a protuberance that represents the tips of the openings of the retrocerebral duct. The buccal plate is reduced to two lateral arcs of cilia, one on each side of the mouth.

The mastax is of the specialized virgate type peculiar to the genus. The construction of the trophi is exceedingly difficult to elucidate by a drawing. It is characterized by a preponderance of the left side over the right. The lateral expansions of the rami are lamellar and form a domelike cavity which helps to support the wall of the mastax during pumping action. The left uncus is joined to the ramus by a subuncus having about twelve curved, flattened teeth; the right subuncus is much reduced, and consists of five or six minute blunt teeth. The right ramus is divided into two similar halves, one being much smaller than the other; each half is surmounted by a fan of comblike teeth. The right uncus works almost between these two elements of the ramus. There are two parallel teeth in each uncus: those of the left being stout and clubbed near the tips; those of the right being long, slender and rodlike. The right manubrium is bacillar and slender, the left being somewhat longer and much stouter.

¹The word "teeth" applied to the prominences on the anterior margin of the lorica of many species of rotifers is somewhat misleading. "Frontal mucro" and the plural "mucrones," as suggested by Mr. David Bryce, are used in these descriptions. The word is especially appropriate as the adjective mucronate is already established in English.

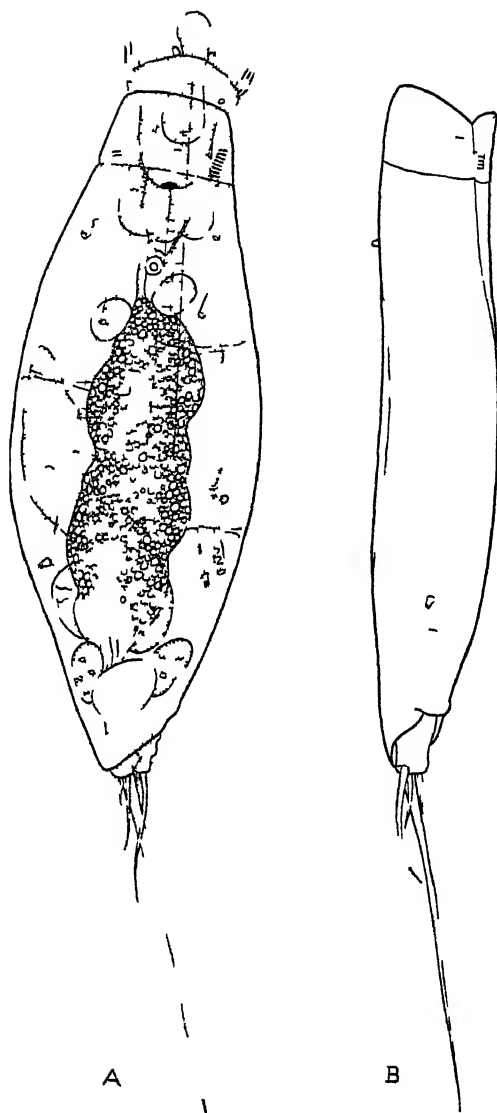


Fig 5 *Trichoceca platessa* new species
A dorsal view B lateral view

The fulcrum is a long lamellar plate which is much expanded at the tip for the attachment of the abductor muscles

The esophagus is long and slender. The stomach is voluminous, often clear, but frequently crowded with chlorophyll granules and fat inclusions. The intestine is very short and hyaline. The nephridial tubes are pronounced and the flame cells are large and prominent even in preserved material. The foot glands and mucous reservoir are normal.

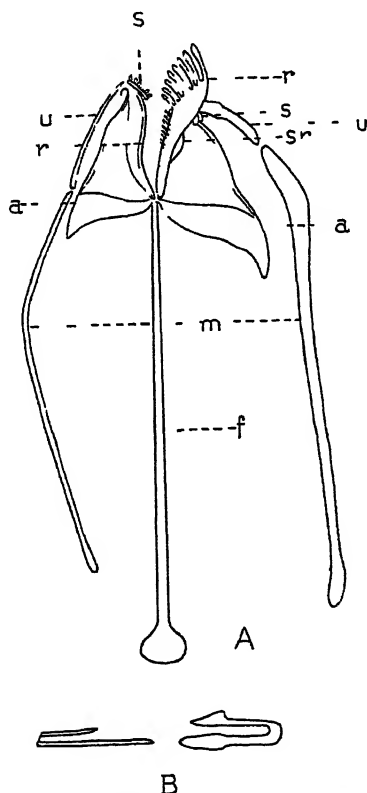


Fig 6 *Trichocerca platessa*, new species

A, trophi, ventral view, somewhat compressed. r, ramus. a, subuncus. u, uncus. sr, secondary ramus. a, alula. m, manubrium. f, fulcrum. B, unci, frontal view.

The retrocerebral sac is relatively small and is strongly vacuolate. The eye is situated at the posterior end of the ganglion.

Average length of lorica, 450μ , width, 180μ ; depth, 85μ , length left toe, 240μ ; right toe, 77μ .

HABITAT — Littoral region of permanent bodies of neutral and acid water.

Trichocerca platessa was first collected in Atlantic County, New Jersey, in 1914. It seems to be fairly common where conditions of exist-

ence permit. Besides being found on the Island, it has also been collected in Polk County, Florida; the Pocono Mountain Plateau, Pennsylvania; Caroga Lake, New York; and Vilas County, Wisconsin.

While the rotatoria are potentially cosmopolitan, this species may be endemic. It seems hardly possible that a rotifer so large and distinctive should remain unobserved outside of the United States for such a long period of time.

The species bears a certain resemblance to *Trichocerca rattus* (Müller) and *Trichocerca elongata* (Gosse). It differs from both in its greater bulk, by the strongly depressed body, and by the differences in the trophi.

Trichocerca platessa is very swift and active in its movements, revolving on its long axis but slightly, which is due to the lack of a dorsal keel and any decided twisting of the lorica. It is frequently infested with the parasite *Pilistophora brachionus* Budde. It is a curious sight to see this rotifer moving about aimlessly, propelled by the involuntary action of the coronal cilia, while the body-cavity is apparently empty except for the presence of numerous parasites.

Trichocerca ornata, new species

Figure 7

The body is short and stout; the anterior portion is clear, and the remainder of the lorica is marked by numerous closely set pustules. There are two small frontal mucrones situated on the anterior margin. The striated area is bounded laterally by two low ridges and extends some distance to the rear of the middle of the body. The foot is quite long and tubular; it is protected by a cylindrical prolongation of the lorica which has a blunt mucro, situated at the posterodorsal edge. The left toe is about equal to the lorica in length; it has a slight bend a short distance from the base, somewhat like the left toe of *Trichocerca stylata* (Gosse) and *Trichocerca pusilla* (Jennings). There is a very short, rudimentary right toe which is closely appressed to the left, and several minute substyles are clustered about the base of each toe.

The circumapical band is reduced to two lateral and one dorsal arc of long cilia. The buccal field is sparsely ciliated and roughly triangular; it is bounded by two lateral arcs of stronger cilia. There is a prominent digitiform process, situated on the apical area, which is bounded laterally by two setiferous tubules.

The mastax is asymmetric and of the specialized virgate type peculiar to the genus. In view of its small size, and other easily ascertained differences, the trophi were not studied in detail.

The eyespot is cervical, and the remaining anatomy is normal.

Length of lorica, 95 μ ; left toe, 100 μ ; right toe, 12 μ ; total length, 210 μ .

HABITAT.—Among marginal aquatics in permanent bodies of neutral and acid water.

Trichocerca ornata is fairly common and evenly distributed throughout the Island. It is common in Atlantic County, New Jersey, and has

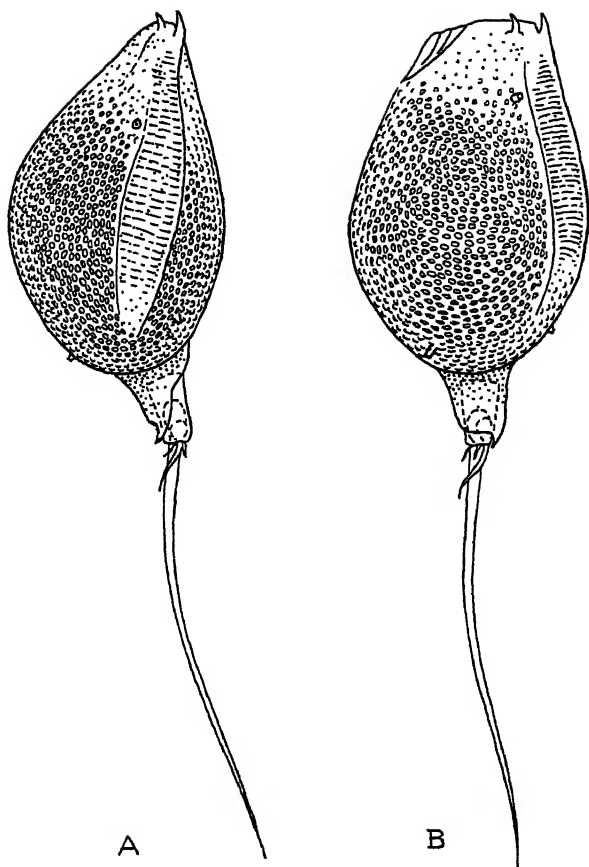


Fig. 7. *Trichocerca ornata*, new species.
A, dorsal view; B, lateral view.

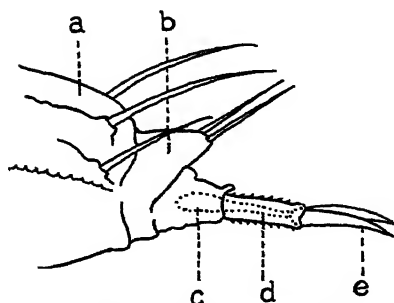


Fig. 8. *Macrochaetus collinsii* (Gosse).
Lateral view of posterior portion of body,
foot, and toes: a, dorsum; b, posterior lobe; c,
first foot joint; d, terminal foot joint; e, toes

also been collected among *Nitella* near the outlet of Caroga Lake, New York. This species is related to *Trichocerca bicuspes* (Pell), from which it differs mainly by having two frontal mucrones, the thick ornamented lorica, the tubular lateral antennae, and the tubular posterior prolongation of the lorica, protecting the foot.

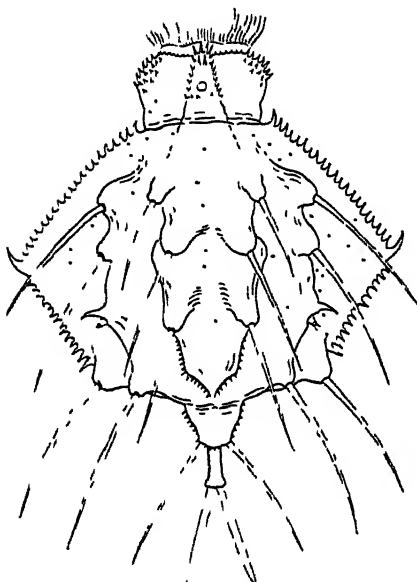


Fig. 9. *Macrochaetus multispinosus*,
New species. Dorsal view.

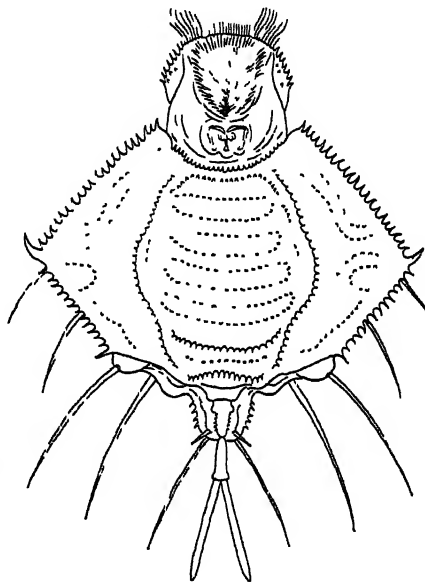


Fig. 10 *Macrochaetus multispinosus*.
Ventral view.

Family BRACHIONIDAE

Subfamily Brachioninae

Macrochaetus multispinosus, new species

Figures 9 and 10

The body is broad and short, strongly hexagonal, compressed dorsoventrally and widest across the middle. The dorsum is arched and the venter is slightly convex. The surface of the lorica is finely punctate, and the lateral edges are bounded by numerous closely set spinules. The lateral angles are very acute, each having a prominent spinule at the summit. There are fourteen long dorsal spines which project from prominences; a pair also project from the lateral angles of the posterior lobe.¹ The venter is rather flat and is ornamented by a series of minute spinules, the

¹The reduced posterior portion of the dorsum in this genus has previously been mistaken for the first foot joint. It is an integral part of the lorica, lying above the foot and is analogous to the posterior lobe in the genera *Lecane* and *Monostyla*. Figure 8 is a lateral view of the posterior portion of the lorica of *Macrochaetus collinsi* (Gosse) and shows the posterior lobe above the basal foot joint.

pattern of which is constant. The foot is composed of two subequal joints. The toes are long and slender, being equal to the foot in length.

On the dorsal side, the head opening is poorly defined, being soft and flexible; the ventral anterior margin of the lorica is concave and beset with a range of numerous spinules. The central ridge and lateral portions of the dorsal hood of the head are also ornamented with prominent spinules.

The lateral antennae emerge from prominent tubules, each being protected by a strong spine, projecting over them. The dorsal antenna is normal.

The mastax is malleate, and the remaining anatomy is normal.

Length of lorica, 60μ ; terminal foot joint, 12μ ; toes, 28μ ; width of lorica, 90μ ; total length with head extended, 140μ .

HABITAT.—Littoral region of lakes and ponds in which the p ranges from 6.6 to 7.2.

Macrochaetus multispinosus was common in the Witch Hole and Lake Wood during several summers. It has been found also in abundance in Atlantic County, New Jersey, and sparingly in collections from Florida. The angular, hexagonal lorica, widest across the middle, and the large number of dorsal spines, together with the relatively very long and slender toes, distinguish this from any other species of the genus.

Macrochaetus longipes, new species

Figure 11

The body is broad and quadrangular, compressed dorsally and widest across the shoulders. The dorsum is arched, and the venter is slightly convex. The surface of the lorica is finely punctate, and the lateral edges are bounded by prominent spinules, those anterior to the shoulders being long, widely spaced and relatively few in number. The lateral angles of the lorica are rounded and each has a very long, prominent spinule at the summit. There are eight long, dorsal spines which project from prominences; a pair also project from the lateral ends of the posterior lobe. The venter is rather flat and finely punctate, but not arranged in a definite pattern, as in the preceding species. The foot is composed of two joints, the terminal being exceedingly slender and about three times the length of the basal joint. The toes are slender and relatively short.

On the dorsal side, the head opening is poorly defined, being soft and flexible; the ventral anterior margin of the lorica is slightly concave and beset with a range of numerous spinules. The central ridge and lateral portions of the dorsal hood of the head are ornamented with prominent spinules.

The lateral antennae emerge from prominent tubules, the base of which is bulbous, much enlarged, and ornamented by numerous spinules. This structure is the same as that of *Trichotria truncata* (Whitelegge), indicating, together with other structural similarities, the close relationship between the genera *Macrochaetus* and *Trichotria*.

The mastax is malleate, and the remainder of the anatomy is normal.

Length of lorica, 120μ ; terminal foot joint, 40μ ; toes, 27μ ; width of lorica, 115μ ; total length with head extended, 225μ .

HABITAT.—Littoral region of lakes and ponds in which the p ranges from 6.6 to 7.2.

Macrochaetus longipes was found during the summer of 1929 among submerged *Fontinalis* in the Witch Hole. It has been collected sparingly in Atlantic County, New Jersey, and was found also in collections from Florida. The long, widely spaced spinules of the lateral edges of the lorica, and the large, bulbous lateral antennae, together with the extremely long, slender terminal foot joint and relatively short toes, distinguish this from the remaining species of the genus.

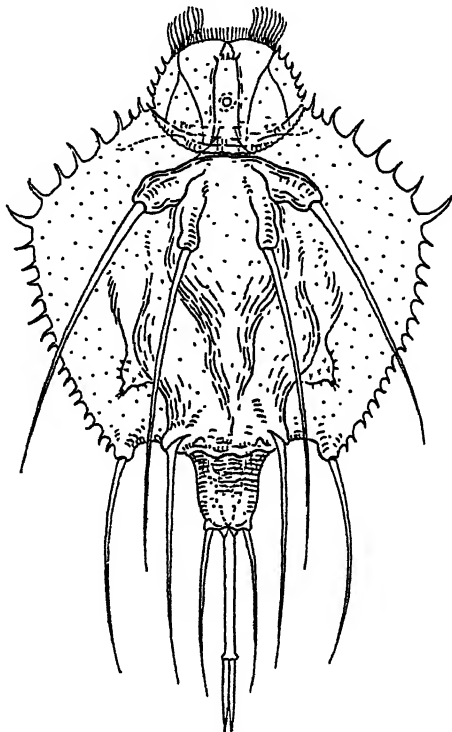


Fig. 11. *Macrochaetus longipes*, new species.
Dorsal view.

Family **BRACHIONIDAE**

Subfamily **Colurinae**

Colurella logima, new species

Figure 12

The lorica is fusiform and laterally compressed from the dorsal view; it is elongate-oval from the lateral view. The venter is split for its entire length. The width of the body, at the widest part, is about two-fifths that of the length. The foot is extremely long, being nearly equal in length to that of the lorica. The first and

second joints are relatively very short and subsquare; the terminal joint is very long and slender, its ventral edge being reinforced and very thick. On the dorsal side of the terminal foot joint, near the distal end, there is a deep sensory pit which is analogous to the same structure in the closely related genus *Lepadella*. Whether this is really the true significance of the structure cannot be definitely established, but it is at least not impossible, reasoning from similar structures in other genera of rotifers. The toes are nearly straight; their length is about two-fifths that of the lorica.

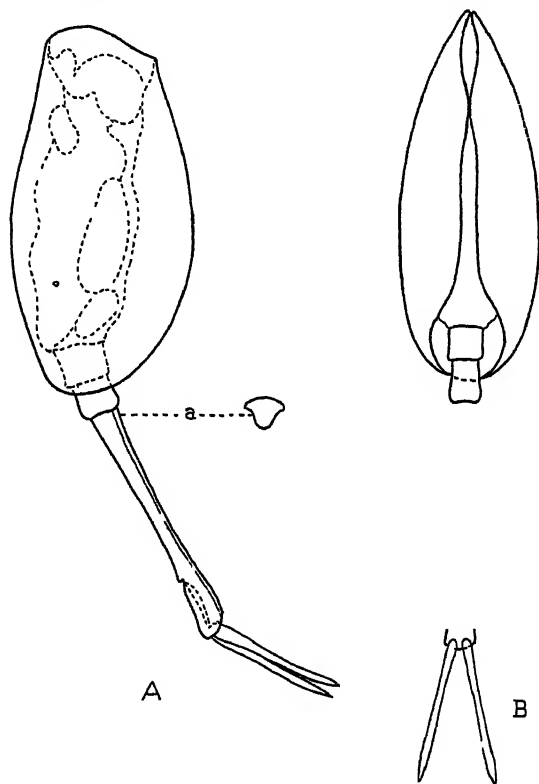


Fig. 12. *Colurella logima*, new species.
A, lateral view: a, cross-section. B, ventral view.

The mastax is malleate, and the internal anatomy is normal.

Length of lorica, 150μ ; first foot joint, 18μ ; terminal foot joint, 115μ ; depth of body, 80μ ; width of body, 60μ ; length of toes, 60μ .

HABITAT.—Submerged *Sphagnum* and *Fontinalis* in permanent bodies of acid water.

Colurella logima was found sparingly in Aunt Bettie Pond and the Witch Hole. It occurs also in Atlantic County, New Jersey. While agreeing perfectly with the other species of the genus in the lorica and

general anatomy, it is strikingly different in the shape of the foot and toes. Its nearest relative is *Colurella aemula* Myers (the following species), from which it may be distinguished by its greater size, and the relatively much more slender and longer foot and toes.

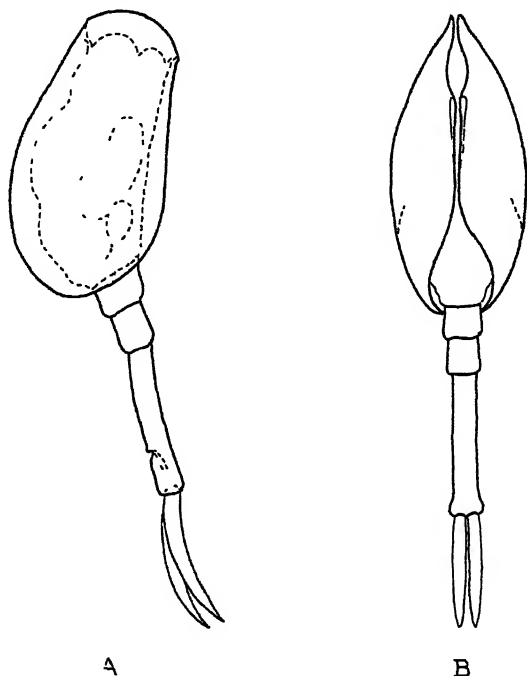


Fig. 13. *Colurella aemula*, new species.
A, lateral view; B, ventral view.

Colurella aemula, new species

Figure 13

This rotifer differs only in details from the preceding species. It is much smaller and the lorica is softer and more gibbous above the lumbar region. The foot is relatively much stouter; the toes are blade-shaped and decurved laterally, and are straight and rather stout from the dorsal view. The habitat is the same for both species; it is more common than *Colurella logima*, which is rare.

Length of lorica, 66μ ; terminal foot joint, 33μ ; toes, 30μ .

Paratypes of all the new species described in this paper have been placed in the collection of The American Museum of Natural History.

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THE DESLONGCHAMPS PUBLICATIONS ON FOSSIL CROCODILES¹

BY CHARLES C. MOOK AND LEONORA R. BORKER

I. INTRODUCTION

In connection with a detailed examination of the literature on fossil crocodiles for monographic purposes, we have noted many references to publications bearing the name Deslongchamps, and that considerable confusion has existed concerning them. It is the purpose of this article to attempt to clear up uncertainties regarding many of these publications.

To accomplish our purpose it is necessary to note the fact that there were two men surnamed Deslongchamps who studied and described fossil crocodiles. They were Jacques-Amand Eudes-Deslongchamps who lived from 1794 to January 18, 1867, and his son called either Eugene Deslongchamps or Eugene Eudes-Deslongchamps who was born in 1830 and died in 1889. We shall consider first the work of the father.

II. JACQUES-AMAND EUDES-DESLONGCHAMPS

The first article on fossil crocodiles published by J. A. Eudes-Deslongchamps that we have been able to find appeared in Volume XIII of *L'Institut* in 1845.² However, this date does not mark the beginning of his interest in fossil crocodiles, for in his description of *Teleosaurus geoffroyi* he mentions the fact that he obtained the material under discussion in 1819. Then, in the discussion of *Steneosaurus megistorhynchus*, Eugene Deslongchamps mentions the fact that his father corresponded with E. Geoffroy St.-Hilaire concerning this fossil. Since Geoffroy St.-Hilaire died in 1844, this correspondence must have taken place previous to that date. The third evidence that J. A. Eudes-Deslongchamps' interest in fossil crocodiles antedated the article in *L'Institut* referred to above, is the mention of an article on the fossil later named *Metriorhynchus blainvillei*, which Eugene Deslongchamps states was published in the *Revue de Caen* in 1844.³

¹Contributions to the Osteology, Affinities, and Distribution of the Crocodilia, No. 28.

²Crocodile fossile découvert à Sannerville, *L'Institut*, XIII, No. 580, pp. 53-56.

³Since this periodical cannot be obtained in the United States, we must provisionally accept this statement until we are able to verify it by consulting the copy in the Bibliothèque Municipale de Caen.

In 1845, we find Jacques-Amand Eudes-Deslongchamps engaged in a debate with H. G. Bronn concerning the position of the internal nares of the teleosaurs. J. A. Eudes-Deslongchamps upheld the views of G. Cuvier and E. Geoffroy St.-Hilaire and stated that the internal nares of the teleosaurs were slightly back of the orbits, and that the orifice in the median line of the base of the cranium was a nerve or vascular foramen. Bronn,¹ on the other hand, believed that this orifice was the internal nares and that the fossa which Cuvier designated as the internal nares was a fracture.

Deslongchamps was supported in the debate by Sir Richard Owen, and Bronn's views were upheld by H. D. de Blainville. However, in a letter published in 1853² de Blainville retracted his statement supporting Bronn, and admitted that Deslongchamps was correct in his beliefs concerning the internal nares. In the course of the debate, Deslongchamps described a fossil head found at Sannerville in which the internal nares were clearly discernible. This specimen was later named *Teleosaurus blainvillei* by J. A. Eudes-Deslongchamps, and was subsequently referred to the genus *Metriorhynchus* by his son.

In 1864, J. A. Eudes-Deslongchamps published his outstanding contribution to the knowledge of fossil crocodiles, his 'Mémoires sur les Téléosauriens de l'Époque Jurassique du Département du Calvados'.³ This memoir contains a long comparison between the skeletal characters of the teleosaurs and the crocodiles, and also a complete description of *Teleosaurus temporalis* (de Blainville) and the original descriptions of two new species of fossil crocodiles. In 1865, he discussed⁴ plans for the second part of the memoir on teleosaurs, but this remained in manuscript form until after his death. Meanwhile, he published several articles establishing new species of crocodiles in the Bulletin of the Linnaean Society of Normandy.

On January 18, 1867, Jacques-Amand Eudes-Deslongchamps died, leaving in manuscript form many notes on his proposed 'Prodrôme' on fossil crocodiles. These notes were revised and edited by his son, to whom we must now turn our attention.

III. EUGENE EUDES-DESLONGCHAMPS

Eugene Eudes-Deslongchamps did not describe or discuss any fossil crocodiles until after his father's death, with the exception of a very brief account of the fossil crocodiles from the Lower Jurassic of Normandy

¹For the articles by Bronn, see bibliography.

²1853, 'Lettres sur les Crocodiles Vivants et Fossiles,' Mém. Soc. Linn. Norm., IX, pp. 109-120.

³1864, Mém. Soc. Linn. Norm., XIII, pp. 1-138.

⁴1865, Bull. Soc. Linn. Norm., IX, pp. 209-210.

which appeared in 1865 in his 'Études sur les Étages Jurassiques Inférieurs de la Normandie.'¹

After 1867, however, Eugene Deslongchamps continued the research that his father had started and wrote several articles on the subject of fossil crocodiles. These articles at first appeared individually and then were printed collectively as part 11 of the 'Notes Paléontologiques.'

In these articles Eugene Deslongchamps redescribed the species of *Teleosaurus* which his father had established, and referred some of these species to other genera. In addition he established several new species of his own.

The following table is a synopsis of the treatment of both father and son.

J. A. EUDES-DESLONGCHAMPS	EUGENE EUDES-DESLONGCHAMPS
<i>Teleosaurus gladius</i> , n. sp.	
<i>Teleosaurus geoffroyi</i> , n. sp.	
<i>Teleosaurus oplites</i> , n. sp.	<i>Steneosaurus oplites</i>
<i>Teleosaurus atelestatus</i> , n. sp.	<i>Steneosaurus atelestatus</i>
<i>Teleosaurus megistorhynchus</i> , n. sp.	<i>Steneosaurus megistorhynchus</i>
<i>Teleosaurus boutillieri</i> , n. sp.	<i>Steneosaurus boutillieri</i>
<i>Teleosaurus edwardsi</i> , n. sp.	<i>Steneosaurus edwardsi</i>
	<i>Steneosaurus roissyi</i> , n. sp.
	<i>Steneosaurus blumembachi</i> , n. sp.
	<i>Teleidosaurus</i> , n.g.
<i>Teleosaurus calvadosii</i> , n. sp.	<i>Teleidosaurus calvadosi</i>
	<i>Teleidosaurus joberti</i> , n. sp.
<i>Teleosaurus blainvillei</i> , n. sp.	<i>Metriorhynchus blainvillei</i>
	<i>Metriorhynchus moreli</i> , n. sp.
<i>Teleosaurus brachyrhynchus</i> , n. sp.	<i>Metriorhynchus brachyrhynchus</i>
<i>Teleosaurus hastifer</i> , n. sp.	<i>Metriorhynchus hastifer</i>
	<i>Metriorhynchus ? incertus</i> , n. sp.

Besides treating with the above forms, Eugene Eudes-Deslongchamps discussed or figured several forms which had been established by other people. These are as follows:

Teleosaurus Geoffroy St.-Hilaire.

Teleosaurus cadomensis Geoffroy St.-Hilaire.

Steneosaurus Geoffroy St.-Hilaire.

Pelagosaurus Bronn.

Pelagosaurus typus Bronn.

Metriorhynchus Meyer

Metriorhynchus superciliosus = *Crocodylus superciliosus* de Blainville.

¹Mém. Soc. Linn. de Norm., XIV, pp. 208-229, part 2, Chapter I, section 2, for the reference to crocodiles.

In addition to the articles which have already been discussed, Eugene Eudes-Deslongchamps wrote two other articles on fossil crocodiles. In one, which appeared in Lennier's paper entitled 'Études Géologiques et Paléontologiques sur l'Embouchure de la Seine et les Falaises de la Haute-Normandie,'¹ he discussed *Metriorhynchus hastifer* and *Metriorhynchus ? incertus*. The other, entitled 'Le Jura Normand,' has not yet been seen by the authors.

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 pp. 95-108 almost exactly reprinted in title 6 above.
 pp. 108-137 expanded into title 7 above.
 pp. 139-162 reprinted in title 13 below.
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I. Observations Préliminaires by Eudes-Deslongchamps, pp. 103-108. [A history of the debate between Bronn and Eudes-Deslongchamps.]

II. Letter by H. D. de Blainville, pp. 109-120. [Original reference for *Crocodylus superciliosus*, and an admittance that Bronn was mistaken in his views concerning the position of the internal nares.]

III. Reply to de Blainville's letter by Eudes-Deslongchamps, pp. 121-131.

IV. Note by Eudes-Deslongchamps, pp. 132-138. [A discussion of a veined sinus on the exterior of the skull of recent crocodiles.]

BIBLIOGRAPHIC NOTES ON THE ILLUSTRATIONS TO THE DESLONGCHAMPS PAPERS

Pl. xi in 'Notes Paléontologiques,' XI, is identical with Pl. ii in Bull. Soc. Géol. de France, Ser. 2, XXVII, and with Pl. xi in Bull. Soc. Linn. de Norm., Ser. 2, I.
 Pl. xii, in 'Notes Paléontologiques,' XI, is identical with Pl. iii in Bull. Soc. Géol. de France, Ser. 2, XXVII, and with Pl. xii in Bull. Soc. Linn. de Norm., Ser. 2, I.
 Pl. xiii in 'Notes Paléontologiques,' XI, is identical with Pl. viii in Bull. Soc. Géol. de France, Ser. 2, XXVII.

Pl. xiv in 'Notes Paléontologiques,' XI, is identical with Pl. iv in Bull. Soc. Géol. de France, Ser. 2, XXVII.

Pl. xix in 'Notes Paléontologiques,' XI, is identical with Pl. v in Bull. Soc. Géol. de France, Ser. 2, XXVII, and with Pl. iii in Bull. Soc. Linn. de Norm., Ser. 1, X (*Teleosaurus calvadossii*).

Pl. xx in 'Notes Paléontologiques,' XI, is identical with Pl. vi in Bull. Soc. Géol. de France, Ser. 2, XXVII.

Pl. xxi in 'Notes Paléontologiques,' XI, is identical with Pl. vii in Bull. Soc. Géol. de France, Ser. 2, XXVII.

Pl. xxiv in 'Notes Paléontologiques,' XI, is identical with Pl. ix in Lennier, G., 'Études Géologiques et Paléontologiques sur l'Embouchure de la Seine et les Falaises de la Haute-Normandie.'

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A NEW SPECIES OF *TELEORHINUS* FROM THE BENTON SHALES

By CHARLES C. MOOK¹

INTRODUCTION

In 1903, Barnum Brown collected some crocodilian remains from the Benton Shales near Pryor, Montana. These remains consisted of two complete skulls with jaws, and an unassociated pair of jaws, besides limb and girdle bones and vertebrae. In 1904, Osborn described one skull and jaws, with vertebrae (Amer. Mus. No. 5851) as *Teleorhinus browni*. Later (1933) this skull was described in greater detail by myself. The other skull (Amer. Mus. No. 5850) has never been described. It is obviously different in characters from *Teleorhinus browni*. The unassociated jaws agree in characters with the jaws of the second skull (Amer. Mus. No. 5850) but not with *T. browni*. This material is now used as the type of a new species which may be called ***Teleorhinus robustus***.

Teleorhinus robustus, new species

TYPE.—Amer. Mus. No. 5850. Complete skull with incomplete lower jaws.

PARATYPE.—Amer. Mus. No. 5849. Complete lower jaws, scapula, humerus, coracoid, plates and vertebrae.

TYPE LOCALITY AND LEVEL.—Twelve miles east of Pryor, Montana, Benton Shales of lower Cretaceous age.

DEFINITION.—Characters of the Genus *Teleorhinus*: cranium much higher and broader, and bones more massive; snout shorter and broader than in *T. browni*. Principal cavities of the skull larger than in *T. browni*. Mandible much stouter than in *T. browni*, the breadth is greater in proportion to the length, and the symphysis is relatively shorter.

DESCRIPTION OF TYPE AND PARATYPE

SKULL

General Form

The skull is long and slender, but is not excessively slender as in *Teleorhinus browni*. The maximum breadth is about ten times the width of the snout at its narrowest point. The point of maximum breadth is far back, across the quadratojugs, but it is not posterior to the cranium.

¹Contributions to the Osteology, Affinities, and Distribution of the Crocodilia, No. 29



Fig. 1A.

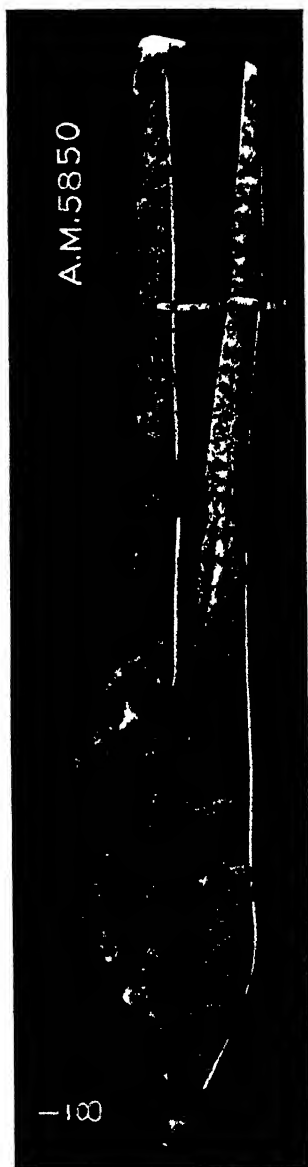


Fig. 1B.

Fig. 1. *Teleorhinus robustus*, new species. Type, skull and jaws, Amer. Mus. No. 5850. One-eighth natural size. A, superior view; B, lateral view, right side.

The cranial table is only moderately developed as a unit by itself. It narrows anteriorly. The snout narrows gradually in the anterior direction, much as in *Tomistoma*. The tip of the snout is bent sharply downward as in *T. browni*.

Cavities of the Skull

SUPRATEMPORAL FENESTRAE.—These cavities are of moderate size. They are relatively large compared with those of short-snouted crocodilians, but relatively small in comparison with many teleosaurs. They are between subcircular and subquadrangular in outline. The transverse diameter of each fenestra is greater than the antero-posterior diameter in about the proportion of eight to seven. The interfenestral bar is of moderate width; the postorbito-squamosal bars separating these fenestrae from the lateral temporal fenestrae are relatively stout.

LATERAL-TEMPORAL FENESTRAE.—These openings are long and appear to have been rather low vertically. This region of the skull has been crushed downward somewhat, rendering it impossible to distinguish the original outlines of these cavities. The small vertical height is undoubtedly due only in part to crushing, however.

ORBITS.—The orbits are much smaller in size than the supratemporal fenestrae. In fact they appear to be relatively smaller than in most crocodilians. They are subcircular in outline, and face chiefly forward, and also partly upward and outward. The outward component of direction is greater than in *T. browni*.

EXTERNAL NARIAL APERTURE.—This cavity occupies nearly the full breadth of the anterior end of the snout. It is subcircular in outline, but its breadth is slightly greater than its length. It is situated entirely anterior to the level of the first maxillary teeth. It covers at least twice the area on the snout that is covered by the aperture in the type of *T. browni*.

INFERIOR PREMAXILLARY FORAMEN.—This opening is not clearly outlined in the specimen. It could not have been large, and it may have been absent. On the other hand it may have been present as a very small opening in a region now occupied by matrix.

PALATINE FENESTRAE.—These fenestrae are long and narrow, and are somewhat irregular in outline. They extend far back on the ventral surface of the skull, leaving only a very short pterygoidal region between them and the posterior border. The space between the fenestrae is relatively broad; it is much broader than the maxillary walls that bound the fenestrae externally.

The region of the internal narial aperture is not sufficiently well preserved to permit description.

The Bones of the Skull

PREMAXILLARIES.—The tips of the premaxillaries bend sharply downward. The posterior processes are very slender. They extend backward to the level of the tenth maxillary teeth. At this level they are wedged apart from each other by the anterior processes of the nasals.

On the palate the premaxillaries extend rather far back, reaching the level of the space between the fourth and fifth maxillary teeth. This portion of the premaxillo-maxillary suture is very irregular. Five alveoli are present in each premaxillary. All of these are located on the downward-turned tip of the snout, and they are all essentially in the same fore and aft level, all ten alveoli being arranged almost in a straight



Fig. 2. *Teleorhinus robustus*, new species. Type, skull, Amer. Mus. No. 5850. One-eighth natural size. Inferior view.

line. The second and third alveoli are the largest in the series and are essentially equal in size. The first and fourth are slightly smaller than the second and third, and are subequal in size. The fifth is the smallest of the premaxillary alveoli. The first three alveoli are situated on the same horizontal level, and essentially on the same fore and aft level; they are close together. The fourth alveoli are separated from the third by a short space; they are much higher in horizontal level, and are very slightly farther back. The fifth alveoli are separated slightly from the fourth; they are higher in horizontal level, and are very slightly farther back.

MAXILLARIES.—The maxillary bones are long and slender. Their contacts with the premaxillaries, on the snout, are about half as long as their contact with the nasals. At the lateral margins they extend back as far as the anterior ends of the orbits.

The premaxillo-maxillary suture on the palate has been described in connection with the description of the premaxillary bones. There is a distinct longitudinal groove separating the palatine portion of each maxillary from the dental border. This is undoubtedly an original character and is not the result of crushing.

The number of teeth in each maxillary is somewhat uncertain, owing to the state of preservation of the specimen. The number is probably thirty-nine, but it may possibly be thirty-eight or forty.

The first fifteen are located on distinct pedicles, and are rather widely separated from each other. These alveoli are essentially uniform in size and are large, being about twice the diameter of the corresponding teeth in *T. browni*. The diameter of each alveolus is about 10 mm. and the spaces between the alveoli are 15 mm.

The maxillo-palatine suture is somewhat obscure, but its form can be determined. It is very short, extending only a short distance forward beyond the anterior ends of the palatine fenestrae. It extends forward and slightly inward from the internal border of each palatine fenestra, near the anterior end of the latter, then curves symmetrically inward toward the mid-line, meeting the latter at a point forty-three millimeters anterior to the level of the anterior tips of the palatine fenestrae, and thence to the opposite side. In form the suture is simple, being essentially a U with slightly diverging arms. It apparently lacks the complex secondary bend near each palatine fenestra that is characteristic of the later crocodilians.

LACRYMALS.—The lacrymal bones are fairly well preserved. They extend forward to the level of the twenty-fifth maxillary teeth. They are long and slender in form. Their contacts with the nasals were apparently short.

PREFRONTALS.—The prefrontals are not as well preserved as are the lacrymals. They appear to be considerably shorter than the lacrymals, and to be somewhat broader at their posterior ends. They occupied more of the orbital borders than did the lacrymals.

FRONTAL.—The outlines of the frontal cannot be distinguished completely, but some portions of them are clear, and other portions are somewhat dimly suggested. The anterior wedge, separating the posterior tips of the nasals, is short and broad. It appears to extend forward to a level slightly anterior to the anterior ends of the orbits. The distance from this level to the anterior ends of the orbits is equal to about one half the antero-posterior diameter of each orbit. The extent of the orbital border occupied by the frontal is not clear, but it appears to be small.

The frontal definitely forms part of the anterior border of each supratemporal fenestra.

POSTORBITALS.—The postorbitals form a greater portion of the supratemporal fenestrae than does the frontal. They also occupy about half of the lateral border of each of these fenestrae. Each postorbital is stoutly constructed, especially at the antero-external corner.

SQUAMOSALS.—The squamosals occupy only one-half the external borders of the supratemporal fenestrae, and about two-fifths of their posterior borders. The external bars of the squamosals are stout, resembling the corresponding bars of the postorbitals. The posterior bar is slender. The postero-external corners are not produced into prominent elevations.

JUGALS.—The jugal bones are long and slender; the jugal bar is much more slender than the postorbito-squamosal bar. The jugals appear to extend forward to a level three to four centimeters anterior to the anterior borders of the orbits.

QUADRATOJUGALS.—The quadratojugals are unusually short. Their contacts with the jugals appear to be only slightly anterior to the level of the posterior ends of the supratemporal fenestrae.

QUADRATES.—The bones are massively constructed especially for a slender-snouted form. Their articular processes are short and broad. The articular surfaces are irregular and are unusually twisted in appearance.

PARIETAL.—The parietal bone is distinctive in character. Its contact with the frontal is not clear. It appears to occupy no part of the anterior border of either supratemporal fenestra, but this is not certain. It may occupy a small portion of each anterior border. The interpretation to be made, in this respect, depends upon the identification of certain indistinct partings as sutures or as cracks. The anterior portion of the interfenestral bar is narrow, but the posterior portion broadens rapidly. The posterior transverse bars of the bone, each of which forms about two-thirds of the posterior border of the corresponding supratemporal fenestra, are long and slender.

SUPRAOCCIPITAL.—The outlines of this bone are not entirely clear, but it occupies a very small area of the skull-top. The bone forms a considerable portion of the occipital surface of the skull.

EXOCCIPITALS.—The exoccipitals are not distinctive, except for the fact that the paroccipital processes are stoutly constructed.

BASIOCCIPITAL.—The basioccipital is distinctive in that the occipital condyle is very stout. This fact becomes very apparent when this skull is compared with that of *T. browni*.

PALATINES.—The palatines, as indicated in the preceding paragraph, do not extend very far forward. They are somewhat broader than is usual in a long-snouted skull of this size, separating the fenestrae somewhat widely. The relations with the pterygoids cannot be distinguished.

PTERYGOIDS.—The pterygoids are very poorly preserved. The bones have two heavily-built processes extending postero-externally from the mid-line. The two pterygoids together form a letter Y.

OTHER BONES.—The other bones of the skull are either poorly preserved or are not sufficiently well preserved to warrant description.

LOWER JAWS

General Form

The lower jaws in the type are imperfectly preserved. Their posterior portions are essentially complete, but over half of the symphyseal region is lacking. This portion has been restored, using the characters of the paratype, and the dimensional limits of the skull.

The paratype specimen (Amer. Mus. No. 5849) is complete except for a few minor details. It was collected in the same locality as the type, and from the same beds. It belonged to a larger individual than the type specimen.

The two rami of the lower jaw form a letter Y, whose arms are longer than its base. The symphysis, comprising the base, or upright, of the Y, is slightly over one-third of the entire jaw in length. The symphysis is thus relatively shorter than in *T. browni*. The breadth of the mandible at its posterior end is relatively about one and one-half times as great as in *T. browni*. The vertical height of each ramus near its posterior end is correspondingly great. The symphysis is broader than in *T. browni* and is thin vertically as in that species. The ratio of height to breadth is about the same in the two species, but both of these dimensions are greater in proportion to the length in the new species than in *T. browni*.

The external mandibular foramen is very small. Its length is much greater than its height.

The Bones of the Lower Jaws

DENTARIES.—The dentaries comprise most of the symphysis, and large portions of the posterior bars. The number of teeth in each dentary is not absolutely certain, as the alveolar borders are not perfect in either specimen. It appears to be thirty-four, but may be thirty-five. The first two pairs of teeth are small, and the rest are somewhat larger. The posterior teeth are, on the whole, smaller and closer together than the anterior ones. All of the teeth are stouter than those of *T. browni*. The first ten or twelve teeth are rather widely separated from each other, and were nearly vertical in position. The remaining teeth were closer together, and were directed obliquely outward and upward. The symphysis ends at the twenty-second teeth.

SPLENIALS.—These bones are long, and their anterior processes are stout. The anterior processes comprise part of the symphysis, extending forward to the level of the twelfth or thirteenth maxillary teeth.

SURANGULARS AND COMPLIMENTARIES.—These bones are not sufficiently distinctive to warrant special description.

ANGULARS.—The angulars are large and massive. They comprise considerable portions of the large postarticular processes.

ARTICULARS.—These bones are massively constructed, both in the region of the large glenoid surfaces and of the postarticular processes.

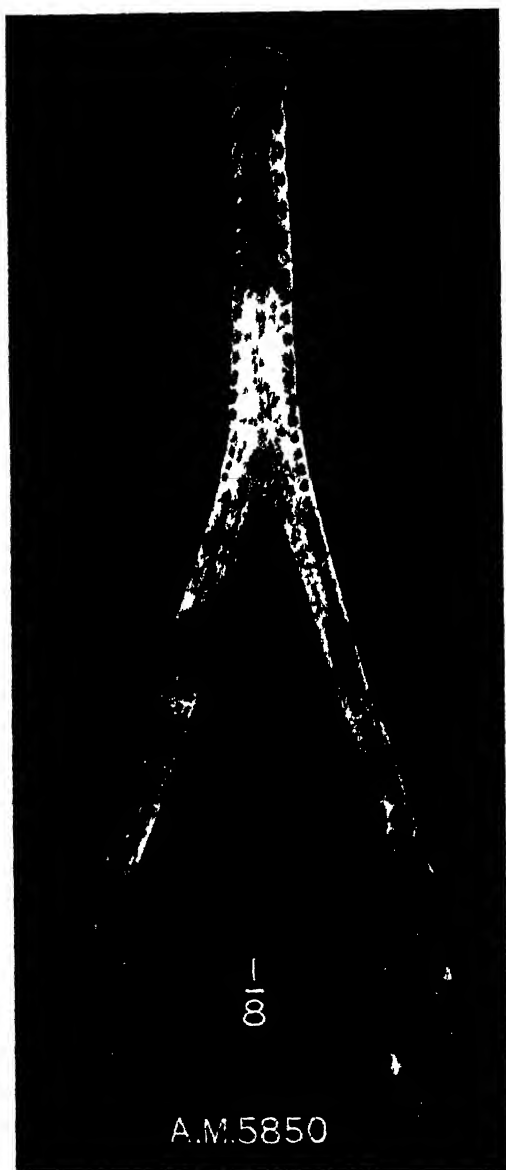


Fig. 3. *Teleorhinus robustus*, new species Type, lower jaws, Amer. Mus. No. 5850. One-eighth natural size. Superior view.



Fig. 4. *Teleorhinus robustus*, new species. Paratype, lower jaws, Amer. Mus. No. 5849. One-eighth natural size. Superior view.

MEASUREMENTS

SKULL.—Type, Amer. Mus. No. 5850.

	mm.
Length, tip of premaxillaries to posterior border of cranial table at mid-line.....	910
Length, tip of premaxillaries to occipital condyle.....	969
Length, tip of premaxillaries to level of articular surfaces of quadrates.....	1022
Breadth, across quadrato-jugals.....	438
Breadth of occiput, maximum.....	340
Breadth, across both supratemporal fenestrae.....	286
Breadth of interfenestral bar.....	20
Breadth across orbits, maximum.....	277
Breadth of interorbital plate.....	135
Breadth of snout at base.....	222
Breadth of snout, minimum.....	64
Breadth of snout at tip.....	83
Length of snout.....	678
Length of right supratemporal fenestra.....	110
Breadth of right supratemporal fenestra.....	133
Length of left supratemporal fenestra.....	111
Breadth of left supratemporal fenestra.....	130
Length of right orbit.....	68
Breadth of right orbit.....	77
Length of left orbit.....	72 est.
Breadth of left orbit.....	68 est.
Length of external narial aperture.....	39
Breadth of external narial aperture.....	46
Length, tip of premaxillaries to posterior end of tooth row.....	744 est.
Length of right palatine fenestra.....	223 est.
Breadth of right palatine fenestra.....	82
Length of left palatine fenestra.....	234 est.
Breadth of left palatine fenestra.....	89
Breadth of occipital condyle.....	61
Height of occipital condyle.....	47
Breadth, right glenoid surface.....	80

LOWER JAWS.—Type, Amer. Mus. No. 5850.

Length (restored).....	1140
Length of symphysis (restored).....	467
Length of tooth row (median, restored).....	655
Breadth, maximum.....	448
Breadth of symphysis, maximum.....	103 est.
Breadth of symphysis, minimum (restored).....	55
Breadth of right articular surface.....	72
Breadth of left articular surface.....	72
Length of right postarticular process.....	158
Length of left postarticular process.....	160 est.
Height of symphysis, minimum.....	27 est.

LOWER JAWS.—Paratype, Amer. Mus. No. 5849.

Length.....	1243
Length of symphysis.....	450 est.
Length of tooth row (median).....	820 est.
Breadth, maximum.....	475
Breadth of symphysis, maximum...	123 est.
Breadth of symphysis, minimum.....	76
Breadth of right articular surface.....	88 est.
Breadth of left articular surface...	85 est.
Length of right postarticular process...	173 est.
Length of left postarticular process.....	168
Height of symphysis, minimum.....	25

CONCLUSIONS

Two species of *Teleorhinus* evidently inhabited the Montana-Wyoming interior sea contemporaneously during Benton time. One of these, *T. browni*, was exceedingly slender. The other, the new species, *T. robustus*, was more massive in construction, and evidently had somewhat different habits and perhaps diet, from the first species.

STUDIES OF PERUVIAN BIRDS. XII

NOTES ON *HYLOPHYLAX*, *MYRMOTHERA*, AND *GRALLARIA*

BY JOHN T. ZIMMER

I am greatly indebted to Dr. C. E. Hellmayr, Vienna, for comparative notes on certain specimens in European museums; also to Field Museum of Natural History, Chicago, and Carnegie Museum, Pittsburgh, for the loan of some material used in the following studies.

Names of colors when capitalized indicate direct comparison with Ridgway's 'Color Standards and Color Nomenclature.'

***Hylophylax punctulata punctulata* (Des Murs)**

Rhopotera punctulata DES MURS, in Castelnau, 1856 (June), 'Expéd. Amér. Sud,' (pt. 7), I (3), Oiseaux (lvr. 18), p. 53—Haut Amazone (restr. to Pebas, Perú; Hellmayr, 1924); "♂" [= ♀]; Paris Mus.

Rhopothera guttata DES MURS, 1856, *tom. cit.* (December), (lvr. 20), Pl. xvii, fig. 3.

Examples at hand from Puerto Indiana and Anayacu are practically topotypes and serve well as a basis for the comparison of material from other regions. A female from Orosa, across the Amazon from Anayacu, and a female from Sarayacu on the Ucayali are similar in all respects to the Puerto Indiana and Anayacu birds. Records from Iquitos and the Río Javari complete the history of this species in Perú.

A series of thirty-one skins from the upper Orinoco, the Cassiquiare, and the Caura in southwestern Venezuela appear to be inseparable from the Peruvian birds, although there is a wide gap in their distribution which avoids northwestern Brazil. The Venezuelan birds average a trifle less broadly striped on the breast, but there are various specimens as heavily marked as the Peruvian birds, a larger series of which might show the same amount of variation.

Seven birds from various localities in Brazil, east of Perú and south of the Amazon, do, however, show a uniformly recognizable difference and justify the separation of a new form which may be described as follows.

***Hylophylax punctulata subochracea*, new subspecies**

TYPE from Limoã, left bank of Rio Tapajoz, Brazil. No. 288,591, American Museum of Natural History. Adult male collected July 24, 1931, by Alfonso M. Olalla.

DIAGNOSIS.—Similar to *H. p. punctulata* of northeastern Perú, but upper surface averaging somewhat brighter; light spots on back and wings less pure white, more tinged with buff; dark area on external margins of primaries at their bases much smaller; dark patch on under wing-coverts at base of primaries less extensive and paler. Males with flanks not gray but dull ochraceous, lower belly and under tail-coverts not white but pale ochraceous; median rectrices not entirely black basad of the pale tips, but with only a subterminal black band and with the basal two-thirds of the feathers dull brownish-olive. Females with posterior under parts more strongly ochraceous; median rectrices with subterminal black band subobsolete and the basal portion warmer brown than in the males.

RANGE.—South bank of the Amazon in Brazil from the lower right bank of the Rio Madeira eastward to the right bank of the Xingú.

DESCRIPTION OF TYPE.—Anterior upper parts from crown to anterior scapulars and interscapulars pale brownish-olive; forehead and an inconspicuous line over the eye light gray; lores white with a dusky or blackish bar on the upper portion, a narrow ring around the eye, the subocular space, and the auriculars white, with the tips of the auriculars blackish; sides of neck a little grayer than the nape; feathers of the middle and lower back black at their tips in increasing degree posteriorly, and with a rounded, faintly buffy white spot just before their tips, these also progressively increasing in size posteriorly; a large, silky white patch concealed in this area near the bases of the feathers; upper tail-coverts broadly black at tips and on lateral margins, but grayish olive centrally. Chin, throat, and malar region black, continuous with the blackish tips of the auriculars; breast white, with upper portion unmarked, forming a crescentic patch; feathers of lower breast and sides with broad central stripes of black beyond their middle, laterally margined with white, making the area heavily striped; upper belly white; lower portion and crissum pale ochraceous; flanks darker and duller ochraceous. Remiges sooty, with bright brownish-olive outer margins except at extreme base and on innermost quills; inner quills black with a large subquadrate patch of buffy white at tips of outer webs; greater upper wing-coverts black with broad buffy white tips; median series similar but with tips less buffy; lesser series brownish olive, with small, pale tips and some black near the tips, the markings obsolete on innermost feathers; alula with white outer margin. Tail mostly black with whitish tips, broad and white on outer rectrices, triangular and more buffy on middle ones; median pair of rectrices with the black reduced to a subterminal band 4 mm. in width (measured on shaft) and the basal two-thirds of the feathers Brownish Olive x Sepia; second pair with outer webs brown in the same proportionate length, third pair with brown reduced to a marginal border on outer web; this color obsolete on remaining rectrices. Bill black (in dried skin); feet light horn-color. Wing, 60 mm.; tail, 30.5; exposed culmen, 16; culmen from base, 18; tarsus, 17.

REMARKS.—Females are as described for the male except that the upper surface is warmer brown, with the black portions withdrawn somewhat from the lateral feathers toward the mid line and with the pale spots deeper buff; upper tail-coverts warm brown instead of black but with narrow blackish tips; median rectrices warm brown with the black subterminal band very narrow. Throat and chin white, continuous with the white crescent on upper breast; a broad black malar stripe from

bill to sides of neck; lower under parts more strongly and extensively ochraceous than in the male, with only a small area on upper belly white. Wing, 59, 59 mm.; tail, 28.25, 30.75; exposed culmen, 14, 14.5; culmen from base, 17.25, —; tarsus, 17, 17.75.

Males show a range of measurements on both sides of the type. Wing, 58–64 mm.; tail, 28.75–33.75; exposed culmen, 15–16; culmen from base, 17.5–18.5; tarsus, 16.5–17.75.

Although some females of *punctulata* have, in a modified degree, the markings on the tail, as exhibited by the males of the new form, none of them approach the females of *subochracea* in this particular, and none of the males appear to have more than a suggestion of brown on the middle rectrices.

The two skins from the lower right bank of the Madeira appear to belong here without question, and, although one of them (not fully adult) has less ochraceous posteriorly than the other males of the series, both have the brown-banded tail of the new form. Hellmayr (Novit. Zool., XIV, p. 377, 1907, and XVII, p. 354, 1910) has noted birds from Calamá and Humaythá as inseparable from true *punctulata*, and it is probable, therefore, that *punctulata* ranges east to the left bank of the Madeira and crosses that stream to its right bank in the neighborhood of the Machados. Further material from this region should be studied.

SPECIMENS EXAMINED

H. p. punctulata.—PERÚ: Puerto Indiana, 2 ♂, 1 ♀; Anayacu, 1 ♀; Orosa, 1 ♀; Sarayacu, 1 ♀. VENEZUELA: Esmeralda, 4 ♂, 1 ♀; Caño León, 6 ♂, 4 ♀; Río Orinoco, mouth of Río Ocamo, 2 ♂, 2 ♀; Lalaja, 1 ♀; Río Cassiquiare, Quemapure, 1 ♀; El Merey, 1 ♀; opposite El Merey, 5 ♂, 2 ♀; La Unión, Río Caura, 1 ♂, 1 ♀.

H. p. subochracea.—BRAZIL: Rio Tapajoz, Limoãl, 2 ♂ (incl. type), 1 ♀; Caxiricatuba, 1 (♀); Rio Xingú, Tapará, 1 ♂; Rio Madeira, Igarapé Auará, 2 ♂.

Hylophylax poecilonota lepidonota (Sclater and Salvin)

Hypocnemis lepidonota SCLATER AND SALVIN, 1880, P. Z. S. London, p. 160—Sarayacu, eastern Ecuador; ♀; British Mus.

Hylophylax poecilonota obscurior (*obscurus* in list of specimens) CARRIKER, 1930, Proc. Acad. Nat. Sci. Phila., LXXXII, p. 369—Puerto Yessup, Río Pichis, Perú; ♀; Acad. Nat. Sci. Phila.

The examination of additional material from northern Perú and eastern Ecuador confirms my earlier belief (Field Mus. Nat. Hist. Publ., Zool. Ser., XVII, p. 335, 1930) that Peruvian birds (except from the extreme southeastern part of the country) are inseparable from typical *lepidonota*. It is evident from Carriker's comparative notes that he compared his supposedly new form, "*obscurior*," with examples, not of

lepidonota, as stated, but of some form much more closely allied to (if not identical with) *duidae*. The description of "*obscurior*" applies in detail to *lepidonota*, and a male from near the type locality of *lepidonota* was placed in the supposedly new form.

The females at hand from Ecuador and Perú are relatively uniform in their dark and dull coloration and in the extensive white area at the base of the interscapulars; the males similarly are all relatively dark gray with the interscapular patch likewise extensive.

On the other hand, a large series from the upper Rio Negro, the Uaupés, the Cassiquiare, and the Cunucunumá in Brazil and Venezuela are strikingly different in the female plumage and recognizably so in the male dress. The females are much brighter rufescent or orange-ochraceous throughout, with the forehead and superciliary region noticeably still brighter, the under wing-coverts also orange-ochraceous, and the white area at the base of the interscapulars much reduced. The males are paler gray with a similarly reduced patch of white on the mantle in many cases, though some examples are not to be told from *lepidonota*. Of twenty-two females from this region, all are quite distinct from typical *lepidonota*.

For this form the name *duidae* is available, the type of which is among the material now at hand. The type and a female paratype are not so strongly marked as the Rio Negro birds but evidently represent the same form at its northernmost extension of range.

Colombian examples are not available in sufficient numbers to settle the question of their identity. Dr. Chapman already has referred two Bogotá skins to *duidae* and three La Morelia skins to *lepidonota*. The La Morelia skins are fairly typical *lepidonota*, but the Bogotá skins are not easily defined. The male is pale but may be faded. The "female" is brighter than *lepidonota* but deeper in tone than females of *duidae*, though not unlike young males. Since it is not fully adult it may be a wrongly sexed immature male. In any case these skins must be retained in *duidae*. Hellmayr (1924) notes two Bogotá females as like Rio Negro examples.

There is no doubt that *lepidonota* is a conspecies of *poecilonota*. The fine series of birds from the base of Mt. Duida affords an opportunity to study the relationship through the intervening form *duidae*. This form is, as stated, easily separable from *lepidonota* by the much brighter rufescent tone of the females and by the somewhat paler gray coloration of the males. Unfortunately, the only material of this bird available to its author at the time of its description was from the edge

of its range where it already begins to show some intermediacy with *poecilonota*. The type locality is at the western base of Mt. Duida on the Río Cucucunumá, whence the subspecies ranges southward to the Cassiquiare, and by that route to the Rio Negro and the Uaupés in Brazil, following the Negro (both banks) eastward to the vicinity of Santa Isabel. It is not found in typical form on the southeastern slopes of Duida, as will be detailed below.

The Guianan form, *poecilonota*, is somewhat variable. Skins of both sexes at hand from British Guiana have the rump much less strongly marked with black subterminal areas and pale (white, ♂; ochraceous buff, ♀) tips than skins from the Rio Jamundá, Brazil, or the upper Orinoco and Caura rivers, Venezuela. Furthermore they have a smaller amount of white concealed on the mantle of the males and no such white on the females. The females, in addition, have the dark subterminal areas on the mantle dull and not very blackish nor very large. Rio Jamundá females have a small trace of white concealed on the back and more pronounced black near the tips of the feathers, and middle Venezuelan birds are like them in respect to the black markings, though they still lack the concealed white patch.

A series from the southeastern side of Mt. Duida, from the north bank of the Orinoco up to an elevation of two thousand feet, are, for the most part, indistinguishable from the Caura and upper Orinoco (Nericagua) skins, though an occasional specimen shows much more white concealed on the back. The skins from one locality in this limited region, Valle de los Monos, near the southern angle of Mt. Duida (the point nearest the range of *duidae*) are distinctly intermediate between *duidae* and *poecilonota*. Of five females from this locality, one is much like the type of *duidae* (though the pale tips of the lower interscapulars are faintly buffy); the second is similar but with dark ochraceous tips on the mantle; the third is more like the first but with the belly medially pale grayish or whitish; the fourth is more like other Venezuelan examples of *poecilonota* but has the throat and breast suffused with ochraceous and the tips of some of the interscapulars whiter than usual; the fifth is no different from the ordinary Venezuelan skins of *poecilonota*. Except the fourth (which is molting on the back), these birds have well-developed white concealed on the mantle. A young male from the same locality is of the *duidae* type but has the tips of the mantle feathers buffy, the belly very pale buffy, and the throat distinctly paler than the chin and malar region, thus suggesting the pattern, though not the exact coloration, of *poecilonota*.

It is strange that *duidae* has not crowded out this outpost of *poecilonota* or merged with it more completely. To reach this region on the southeastern slopes of Mt. Duida, *poecilonota* may have broken away from the Orinoco not far from Nericagua and followed the slopes of the Serra Parima across to the northward of Mt. Duida to meet the Orinoco again near Esmeralda; it may have crossed the Pacaraima Mountains at the head of the Caura Valley where there appears to be a pass between 500 and 1000 meters in elevation, just within the known vertical range of this bird; or it may have spread from the Rio Jamundá along the southern slopes of the Pacaraimas to the head of the Orinoco and thence to Mt. Duida. In any case, the Cassiquiare and Cunucunumá birds, as shown in the material before me, represent the form described as *duidae*.

Occasional females from eastern Colombia are as brightly colored as *duidae* but seem to represent the extreme of *lepidonota* in the direction of the other form rather than the reverse. Typical *lepidonota* from eastern Ecuador has distinctly duller females, as is mentioned above.

The specimens of so-called *lepidonota* from the "Rio Solimões" with which Carriker compared his supposed new *obscurior* are discussed as being so brightly colored in the female plumage as to point to their identity with *duidae*. I surmise that they came from the neighborhood of Tonantins or from some not far distant point on the north bank of the Solimões to which *duidae* may be expected to extend from the upper Rio Negro.

Records of *lepidonota* from Perú, other than those of the specimens listed below, are from La Merced, Huayabamba, Nuevo Loreto, Pozuzo, Monterico, Iquitos, Chamicuros, Yurimaguas, Huambo, and Puerto Yessup.

***Hylophylax poecilonota griseiventris* (Pelzelin)**

Pithys griseiventris PELZELN, 1868 (September), 'Orn. Bras.', II, p. 167—Villa Maria, Engenho do Gama, and Borba (restricted to Borba, Hellmayr, 1924); cotypes in Vienna Mus.

The sole record from Perú is based on a single female collected by Harry Watkins at Astillero, southeastern Perú, already noted by Dr. Chapman (Amer. Mus. Novit., No. 86, p. 7, 1923). This bird agrees with two examples (one male and one female but both not quite adult) from Teffé, Brazil, in being slightly less strongly rufescent on the upper surface than skins from the Rio Madeira, but the differences are not great and are largely overcome by individual variation. Without larger series from the western part of the range, it would be unsafe to separate

a new form, although Hellmayr (Novit. Zool., XIV, p. 67, 1907) has noted the same condition in other Teffé females.

There are no records from Bolivia, where the form almost certainly occurs, since it exists in Matto Grosso, Brazil, across northern Bolivia from Perú.

A female from Rosarinho, Rio Madeira, shows affinity to *lepidonota* by having small buffy white tips on the lower mantle feathers preceded by even fainter dusky subterminal markings, broad buffy tips on the inner remiges and upper wing-coverts, and a trace of dull whitish on the middle of the inner webs of some of the rectrices. The general color of the back is less rufescent than that of the Astillero bird. Similar traces of the same sort are seen in other specimens, notably a female of *nigrigula* from Villa Bella Imperatriz. Actually this tendency may indicate a reduction in the degree of sexual dimorphism, since the markings in question, also found in some young males, are modified copies of the dorsal pattern (but not color) of adult males.

Incidentally, as may be seen from the subjoined list of specimens, *nigrigula* is not confined to the left bank of the Tapajoz, as heretofore supposed, but occupies the lower right bank as well. Madame Snethlage's record of *vidua* from the Rio Jamauchim (Tucunaré), if based on a female, may well belong here also; if based on a male, both forms may occur in this region at different places, but I suspect rather that the Tucunaré record is assignable to *nigrigula*.

SPECIMENS EXAMINED

H. p. poecilonota.—BRITISH GUIANA: 4 ♂, 3 ♀. BRAZIL: Faro, 5 ♂, 3 ♀. VENEZUELA: La Unión, Río Caura, 1 ♀; Nericagua, Río Orinoco, 1 ♀; southeastern slopes of Mt. Duida, 325–2000 ft. (Campamento del Medio, Playa del Rio Base, Caño Seco, Savana Grande, Esmeralda, Río Pescada, Pie del Cerro), 9 ♂, 10 ♀; Valle de los Monos,¹ 2 ♂, 5 ♀.

H. p. duidae.—VENEZUELA: foot of Mt. Duida (western side), Río Orinoco (near Río Cunucunumá), 5 ♂, 2 ♀ (incl. type); Río Orinoco (left bank), opposite mouth of Río Ocamo, 1 ♂; Río Cassiquiare, Solano, 1 ♂; El Merrey, 3 ♀; opposite El Merrey, 2 ♀; Río Huaynia (right bank), confluence with Cassiquiare, 1 ♂, 3 ♀. BRAZIL: Río Uaupés, Tahuapunto, 6 ♂, 2 ♀; Río Negro, Tatú, 4 ♂, 3 ♀; Mt. Curucuryari, 4 ♂, 4 ♀; Yucabi, 4 ♀; Tabocal, 1 ♀; Santa Maria, 1 ♀; San Gabriel, 2 ♂. COLOMBIA: "Bogotá" (not typical), 1 ♂, 1 ♀ (?).

H. p. lepidonota.—ECUADOR: Zamora, 2 ♂, 2 ♀; Río Suno, above Avila, 1 ♂, 1 ♀; lower Río Suno, 1 ♂, 1 ♀; below San José, 4 ♂; mouth of Río Curaray, 1 ♂, 4 ♀. COLOMBIA: La Morelia, 1 ♂, 2 ♀. PERÚ: Puerto Indiana, 1 ♂; Río Seco, west of Moyobamba, 2 ♂, 2 ♀; Pomará, Río Marañón, 3 ♀; Vista Alegre, 1 ♂²; Puerto Bermúdez, 1 ♀²; Lagarto, upper Ucayali, 1 ♂.

¹Intermediate between *poecilonota* and *duidae*.

²Specimens in Field Museum of Natural History, Chicago.

H. p. griseiventris.—PERÚ: Astillero, 1 ♀. BRAZIL: Rio Madeira, Borba, 2 ♂, 3 ♀, 1 (?); Igarapé Amorín, 1 ♂, 4 ♀; Rosarinho, 1 ♀; Santo Antonio de Guajará, 1 ♂; Rio Roosevelt, "Camp 14," 1 ♂; Teffé, 1 ♂, 1 ♀.

H. p. gutturalis.—BRAZIL: São Paulo de Olivença, 3 ♂¹, 3 ♀¹.

H. p. nigrigula.—BRAZIL: Villa Bella Imperatriz, Rio Amazonas, 4 ♂, 4 ♀; Rio Tapajoz (right bank), Santarem, 1 ♂; Tauary, 1 ♂; Caxiricatuba, 4 ♂, 2 ♀, 1 (?); (left bank), Limoál, 2 ♂, 2 ♀; Igarapé Brabo, 4 ♂, 2 ♀.

H. p. vidua.—BRAZIL: Providencia, Pará, 1 ♂; Mocajuba, 1 ♂; Ananindeua, 1 ♀; Utinga, 1 ♀; Benevides, 3 ♂¹, 3 ♀¹; Turyassú, Maranhão, 1 ♂², 1 ♀²; Rio Tocantins, Arumatheua, 1 ♂; Baião, 1 ♂, 2 ♀; Mocajuba, 4 ♂, 3 ♀, 1 (?); Rio Xingú, Villarinho do Monte, 2 ♂, 2 ♀; Porto do Moz, 1 ♂, 2 ♀.

***Myrmothera campanisona minor* (Taczanowski)**

Grallaria minor TACZANOWSKI, 1882, P. Z. S. London, p. 33—Yurimaguas; ♂; type formerly in Warsaw Mus., now lost.

Seventy-four skins of this species are at hand from various parts of its range including thirteen from northern Perú. An examination of this material has shown that some rearrangement of the group is necessary. The name *minor* has been applied to all the birds of Perú, eastern Ecuador, southeastern Colombia, and western Brazil south of the Amazon, east to the Rio Juruá and the Rio Purús. Natterer's record from Marabitanas has been placed with typical *campanisona* (with a query), and a form, *subcanescens*, has been separated from the region lying between the Rio Madeira and the right bank of the Rio Tapajoz.

The Peruvian examples from south of the Amazon west across the bend of the middle Marañón, appear to belong to a single subspecies which is *minor*. I have no exact topotypes, but specimens from both east and west of Yurimaguas show no recognizable differences. The upper side is close to Medal Bronze in color, with the top of the head usually a trifle duller; the pectoral markings are buffy olive, of moderate intensity, and the flanks are medium gray adjoining the belly but broadly olivaceous laterad.

Birds from eastern Ecuador (and probably northeastern Perú, north of the Amazon) are noticeably darker and more rufescent, with a more strongly contrasting cap, heavier marks on the chest, and darker flanks, and are also smaller.

Skins from southeastern Colombia (Florencia and La Morelia) are again lighter above, but with a browner tone than that of *minor*, and are more delicately marked on the chest and paler on the flanks, while the size is small. They are even more distinctly separable from the Ecua-

¹Specimens in Carnegie Museum, Pittsburgh.

²Specimens in Field Museum of Natural History, Chicago.

dorian series than they are from *minor*, though they are geographically closer. They are equally distinct from the olive-backed and gray-flanked *modesta* from the Bogotá region and find their nearest affinity in a series of skins from the Río Cassiquiare, the foot of Mt. Duida, both banks of the upper Río Negro, and the right bank of the latter stream down to near its mouth. This series is decidedly different from true *campanisona*, which ranges from the Guianas to the north bank of the Amazon at Faro and is recognizable by its light rufescent back and relatively rufescent pectoral markings. The Cassiquiare form, to which Natterer's Marabitanas specimens must belong, is more like *minor* than *campanisona*, but is lighter and clearer above and more lightly marked on the chest and flanks, and is also smaller.

The Tapajoz form, *subcanescens*, is very like *campanisona* above, though sometimes a little duller, while the markings of the chest are grayer or more olivaceous and less rufescent or brownish in color, the flanks are darker, and the tail is longer, though the other measurements are much the same, possibly averaging a little greater. Presumably this form ranges west to the right bank of the Río Madeira.

West of the Río Madeira the birds are as lightly marked on the chest as the Cassiquiare examples, but the back is at the extreme of olivaceous tone, judging by an adult and an immature female from Rosarinho. However, so closely do these skins compare to the Cassiquiare specimens that I refer them to that form for the present.

No names are available for the east-Ecuadorian and Río Negro-Cassiquiare forms, and they are accordingly described and named herewith, with additional notes on each.

Records from Perú which belong to *minor* are from Yurimaguas, Chamicuros, Chuchurras, and the Río Javari, besides Pomará and Puerto Bermúdez which are among the localities from which material has been examined for the present study. The Pebas record is discussed under the following form.

***Myrmothera campanisoma signata*, new subspecies**

TYPE from below San José, eastern Ecuador. No. 184,361, American Museum of Natural History. Adult male collected April 8, 1924, by Carlos Olalla and Sons.

DIAGNOSIS.—Similar to *M. c. minor* of northern Perú (south of the Amazon) but distinctly darker and more rufous on the upper surface, more heavily marked on the breast and sides, and more broadly and deeply gray on the flanks; size smaller except for length of tail. Not so rufous above as *campanisona* but darker and with the top of the head noticeably duller and darker; markings on breast and sides more olivaceous, less rufescent.

RANGE.—Eastern Ecuador (probably reaching northeastern Perú north of the Amazon.

DESCRIPTION OF TYPE.—Back dark Argus Brown (x Brussels Brown); top of head Fuscous; lores dull buffy with sooty tips; auriculars fuscous; malar region a little paler and grayer; chin and throat white with tips finely olive-brown; breast with sagittate white centers and dull Medal Bronze latero-terminal margins which are wider on the sides of the breast where the white centers are reduced to shaft-stripes; outer border of flanks narrowly dark Medal Bronze; inner portion and sides of belly Neutral Gray on margins, with broad white shaft-stripes on upper flanks, obsolete on lower flanks; middle of belly white; under tail-coverts dark Dresden Brown, brighter and more rufescent at tips. Tail blackish with outer margins and all of middle rectrices Mars Brown; wings Fuscous; outer margins of wings and exposed portions of upper wing-coverts Mars Brown; under wing-coverts Ochraceous-Orange x Ochraceous-Tawny; inner margins of remiges Avellaneous x Cinnamon. Bill (in dried skin) blackish; base of mandible whitish; feet light brown. Wing, 81 mm; tail, 36; exposed culmen, 17; culmen from base, 21.5; tarsus, 41.5.

REMARKS.—Female similar but averaging somewhat smaller.

Six males have the following measurements: wing, 77–84 mm. (av. 80); tail, 28–34.5 (av. 32.5); culmen from base, 20.5–21.5 (av. 21); tarsus, 37–41.5 (av. 39.9). Five females: wing, 76.5–80.5 mm. (av. 79); tail, 29–36 (av. 33.2); culmen from base, 20–21 (av. 20.6); tarsus, 39–41 (av. 40).

Eight males of *minor* measure as follows: wing, 83–88 mm. (av. 85.6); tail, 31.5–38 (av. 34.6); culmen from base, 21–25 (av. 23.2); tarsus, 42–44 (av. 42.9). Four females: wing, 78–86.5 mm. (av. 82.1); tail, 29.5–39 (av. 33.4); culmen from base, 20–23.5 (av. 23.2); tarsus, 41–45 (av. 42.2).

Some examples of the new form have less olive or Medal Bronze on the flanks than the type, and one topotypical male has very little olivaceous tone anywhere on the under surface, with the margins of the pectoral feathers Neutral Gray like the flanks. Those specimens with the grayest under parts are inclined to be more olivaceous on the upper surface, while those with the most olive or bronzy-olive breast (most like *minor* in this respect) are the most rufous above (the least like *minor*).

Certain skins have the top of the head even more deeply fuscous than the type but others are no darker than *minor*. Immature examples are not always clearly separable from *minor*, especially from young *minor*, but the two forms in series are readily distinguishable as are most individuals.

There is a record from Pebas, on the north bank of the Amazon, east of the Río Napo, which belongs here without much question, though there is a slight possibility that it may be referable to the Río Cassiquiare form, next described.

***Myrmothera campanisona* dissors, new subspecies**

TYPE from the Río Cassiquiare, Venezuela, right bank, opposite El Merey. No. 417,393, American Museum of Natural History. Adult male collected April 20, 1929, by the Olalla brothers.

DIAGNOSIS.—Back less rufescent than in *M. c. campanisona* or *subcanescens* paler than in *minor*, much paler than in *signata*, less olivaceous than in *modesta*, latero-terminal borders of pectoral feathers duller than in the other forms; flanks lighter, less strongly grayish.

RANGE.—Río Cassiquiare and the foot of Mt. Duida, Venezuela, westward to southeastern Colombia and southeastward along the right bank of the Río Negro (Brazil) to its mouth, apparently crossing the Amazon to the left bank of the lower Río Madeira.

DESCRIPTION OF TYPE.—Upper surface Dresden Brown x Raw Umber. Lores dull whitish with fine brownish tips; auriculars dark Buffy Brown; chin and throat white with inconspicuous grayish-olive tips, strongest laterally; breast with latero-terminal margins dull Light Brownish Olive enclosing a sagittate, white, central area; sides with the dark margins broader and the white median portions reduced to narrow shaft-lines; inner flank-feathers white with narrow lateral margins Smoke Gray, the margins broader and more brownish laterad, approaching the color of the back on the outermost; thighs and under tail-coverts buffy brown. Outer surface of remiges somewhat warmer than the back, approaching Brussels Brown; upper wing-coverts near the color of the back; inner margins of remiges dull cinnamonaceous; under wing-coverts bright ochraceous-cinnamon. Tail near Prout's Brown. Bill (in dried skin) blackish with base of mandible dull yellowish; feet dull grayish-brown. Wing, 85 mm.; tail 36; exposed culmen, 16.5; culmen from base, 20; tarsus, 39.

REMARKS.—Females like the males in color but averaging somewhat smaller. Wing, 79–82 mm. (av. 79.8); tail, 31–37 (av. 33); culmen from base, 19–21.75 (av. 20.6); tarsus, 38–42 (av. 40.7). The series of males measures: wing, 80–85 mm. (av. 82.3); tail, 32–36 (av. 34.5); culmen from base, 20–23 (av. 24.6); tarsus, 39–43 (av. 40.6).

An immature female from the "Campamento del Medio," Mt. Duida, has the mantle, sides of breast and sides of head (including lores and superciliary region), chin and throat, and remiges and rectrices apparently adult. The whole top of the head (from forehead to nape is rich Bay; the center of the breast is Bay; the sides of the upper belly are Hazel; the remainder of the belly is white, tinged with Hazel; the flanks are Bay; the rump is Bay; the upper wing-coverts are brownish like the back but with dull Auburn tips; the scapulars are dull Bay.

There is some variation among the adults in various directions, but the combination of characters is not duplicated in any of the other known forms. No example at hand is as olivaceous above nor so broadly gray on the flanks as *modesta* (represented by a skin from Villavicencio,

Colombia); four examples from southeastern Colombia (Florescia and La Morelia) are among the darkest of the series, probably showing a tendency in the direction of *signata* of eastern Ecuador. Similarly there is no indication of the rufescence of *campanisona* or *subcanescens*. Two specimens from Rosarinho, on the left bank of the Madeira near its mouth, appear to belong to *dissors*, though they are at the light end of the series. They can not be matched even approximately in *subcanescens* to the eastward or *minor* to the westward, but are very close to certain examples of *dissors* without matching them perfectly. A series from the western bank of the Rio Madeira will be necessary to establish their exact identity.

SPECIMENS EXAMINED

M. c. campanisona.—FRENCH GUIANA: Tamanor, 2 ♂, 1 ♀. BRITISH GUIANA: Tumutumari, 1 ♂. BRAZIL: Faro, 5 ♂.

M. c. subcanescens.—BRAZIL: Rio Tapajoz, Tauary, 3 ♂; Aramaní, 5 ♂, 1 ♀; Igarapé Amorín, 1 ♀; Imoãl, 1 ♀; Igarapé Brabo, 3 ♂, 2 ♀, 1 (?) ; Rio Amazonas, Villa Bella Imperatriz, 1 ♂.

M. c. minor.—PERÚ: Rio Negro, west of Moyobamba, 1 ♂; Pomarí, 1 ♂, 1 ♀; Orosa, 2 ♀; Lagarto, Rio Ucayali, 4 ♂, 1 ♀; Santa Rosa, Rio Ucayali, 2 ♂; mouth of Rio Urubamba, 1 ♀; Puerto Bermúdez, 1 ♂¹.

M. c. signata.—ECUADOR: below San José, 2 ♂ (incl. type), 2 ♀; mouth of Rio Curaray, 1 ♂, 1 ♀; Rio Suno, above Avila, 3 ♂, 1 ♀; lower Rio Suno, 1 ♀.

M. c. modesta.—COLOMBIA: Villavicencio, 1 ♂.

M. c. dissors.—VENEZUELA: Rio Cassiquiare (left bank), El Meray, 1 ♂, 1 ♀; (right bank), opposite El Meray, 1 ♂ (type), 1 ♀; Rio Huaynia, confluence with Cassiquiare, 1 ♂; Mt. Duida, Lalaja, 1 ♂; Caño León, 1 ♂; "Campamento del Medio," 1 ♀; Playa del Rio Base, 1 ♂. BRAZIL: Rio Negro, Tatú, 1 ♂; San Gabriel, 1 ♂, 1 ♀; Yavanari, 1 ♀; Igarapé Cação Pereira, 1 ♂; Rio Madeira (left bank), Rosarinho, 2 ♀. COLOMBIA: Florescia, 1 ♂, 1 ♀; La Morelia, 2 ♂.

Grallaria albigula Chapman

Grallaria albigula CHAPMAN, 1923 (Aug. 28), Amer. Mus. Novit., No. 86, p. 8 - Santo Domingo, s. e. Perú; ♂; Amer. Mus. Nat. Hist.

The type and paratypes of this interesting bird still remain the only recorded examples. A careful comparison of them with other species shows no near relative among Peruvian forms, but a definite relationship, however interrupted, with the *nuchalis* group of Ecuador and Colombia, in which I include *ruficeps*.

There are many points of resemblance in structural details and some in coloration, while the differences are not so basic. The wing-formula is similar; the tail and legs are similarly long; the contrasting lines of the top of the head and the back, the whitish markings of the loreal and

¹Specimen in Field Museum of Natural History, Chicago.

anterior facial region, and the more deeply rufescent tone of the auriculars compared with the crown are features in common though not of equal development. The bill in the *nuchalis* group is somewhat heavier and more strongly decurved at the tip, and the under parts are gray (of different shades) instead of whitish as in *albigula*, though grayish toward the sides and flanks, and the circumocular ring is not complete nor so conspicuous. Nevertheless the relationship is closer between *albigula* and the *nuchalis* group than between either of them and any other species. Consequently I would place these species next to each other while recognizing their specific distinction. They are evidently of considerable antiquity and have long been separated with no known relative occupying the great extent of the Peruvian Andes now between their ranges.

SPECIMENS EXAMINED

G. albigula.—PERÚ: Santo Domingo, 2 ♂ (incl. type), 1 ♀.

G. n. nuchalis.—ECUADOR: Baeza, 1 ♂; Maspá, 1 ♂; Oyacachi, 1 ♀; upper Sumaco, 1 ♂, 3 ♀.

G. n. obsoleta.—ECUADOR: Mt. Pichincha, 1 ♂, 1 ♀; Verdecocha, 1 ♂; Río Blanco, below Mindo, 1 (?).

G. n. ruficeps.—COLOMBIA: Almaguer, 2 ♂, 2 ♀; Laguneta, 2 ♂, 1 ♀; "Bogotá," 1 (?); no locality, 1 (?).

Grallaria erythroleuca Sclater

Grallaria erythroleuca SCLATER, 1873, P. Z. S. London, p. 783—Huasampilla (=Huaisampillo), Perú; British Mus.

A male from Occobamba Valley has been compared with all available species and shows no very close relationship to any except *G. rufo-cinerea* of Colombia. With this, however, it has a great many points in common, in spite of the first impression of distinction. In the first place both have the same proportions of wings, tail, bill, and feet. The upper surface is warm rufescent with the head only a little brighter than the back and with the lores (in the male sex) a trifle paler but not at all whitish. The remiges are broad to near the tips. The texture of the plumage is the same. The wing-formula is the same. The bill and feet of *erythroleuca* are heavier but in length are proportionate to the other measurements.

The differences are of color but not of pattern. In *erythroleuca*, the throat is white, the breast rufous-ochraceous with broad white tips in the middle, the sides and flanks are darker than the breast but without white tips, at least on the exterior feathers, and the belly is white. In *rufo-cinerea*, the throat is rufous, not white, but different from the breast

which is gray, with only a suggestion of white tips; sides and flanks darker than the breast; the belly is whitish at tips. Above, as mentioned there is much similarity in the two birds.

It may be concluded that *erythroleuca* and *rufo-cinerea* are both members of the same ancient group of which only the two ends are now left. On account of their somewhat pronounced differences and their wide geographical separation, they may be left as distinct species, though they should stand next to each other in the check lists.

At present, *erythroleuca* is known only from the mountain chain just east of the Río Urubamba, on both slopes of which it has been found at Huaisampillo and Occobamba Valley.

SPECIMENS EXAMINED

G. erythroleuca.—PERÚ: Occobamba Valley, 1 ♂.

G. rufo-cinerea.—COLOMBIA: Laguneta, 2 ♂, 2 ♀; above Salento, 1 ♂.

Grallaria ruficapilla albiloris Taczanowski

Grallaria albiloris TACZANOWSKI, 1880, P. Z. S. London, p. 201 Cutervo and Callacate, Perú; type from Cutervo (♂), formerly in Warsaw Mus., now lost.

I have at hand forty-two skins from the central and western Andes of northwestern Perú which appear to represent two relatively distinct subspecies, to one of which the name *albiloris* should be applied. Unfortunately the birds from the eastern side of the western cordillera, but west of the Marañón, are somewhat intermediate in characters, and it was to specimens from this region that Taczanowski applied his name. Nevertheless this region is connected with the western slopes of the western Andes (at least in places) by a nearly continuous belt of the Subtropical Zone, the habitat of the species thereabouts, but is separated from the central Andes by the cañon of the Marañón with its arid conditions. Furthermore, Taczanowski, after describing *albiloris*, examined specimens from the central Andes which he found to differ from his typical series in certain respects that are apparent in the material now before me, together with other differences not noted by Taczanowski. Consequently it seems best to consider the Pacific slope birds as extreme examples of typical *albiloris* and to describe the central Andean birds as new.

Taczanowski compared his *albiloris* with *G. ruficapilla* of Antioquia and found the bill of the Peruvian birds to be distinctly longer. This is true of the western birds but not of the easternmost ones. Furthermore, he discussed the blackish line separating the white shaft-stripes from the olive margins of the lateral breast-feathers, a character best

developed in the west. Later the Chachapoyas examples were found to have the rufous of the head more intense, the white of the under parts more yellowish, the lores and subocular region more extensively varied with blackish, and the rufous (= orange-ochraceous) markings on the pectoral spots more pronounced. These characters are all variably apparent in the series at hand from the Chachapoyas region. In addition, I have found the western birds to have the pale eye-ring usually less developed and less whitish, frequently strongly ochraceous-rufous, only a little lighter in color than the crown and not defined as an eye-ring, but in other examples it is broad and conspicuous, though never as pronounced and white as it is in central Andean specimens. A Huancabamba male approaches the new form in this respect, but two females from San Felipe, Río Huancabamba, have very little tendency in this direction. These three birds have a somewhat grayer tone on the back and sides than most of the examples from the Pacific slope, especially one female from San Felipe which has less olive or brownish tone than any of either series. The Pacific slope examples average clearer olive on the back than the new form but they are mostly in fresher condition and worn specimens are not well marked in this respect. Some are very dark and others light, with much individual variation. Aside from size, the best character of *albiloris* as distinct from the new form is the notable development of the dusky lines separating the white shaft-streaks from the brown or olive margins on the breast, sides, flanks, and rump.

A single male from Loja, Ecuador, is exactly intermediate between *albiloris* and *connectens*. Even the lores are pale ochraceous and the eye-ring is barely suggested; there is a slight extension of the rufescence of the auriculars on to the sides of the lower throat and subocular space; the rufous of the top of the head is relatively light; the back is touched with grayish at the tips, and there is a grayish tone in the olive of the sides and flanks which are not so heavily marked as in *connectens*. Two young males from Hacienda Limón, west of the Marañón, near Balsas, are virtually inseparable from the central-Andean form which occurs east of Balsas on the opposite side of the Marañón Valley. It is only by a very close study of the two forms in series that the characters of *albiloris* can be discerned in the Hacienda Limón specimens. Probably a series of adults from this locality would show better correlation with *albiloris* than do these two immature specimens. The distinction between the two forms is to be expected on opposite sides of the valley hereabouts, since there is a definite break in the Subtropical Zone through the interposition of the arid cañon of the river. Between Hacienda Limón and the

general range of *albiloris* there may be a slight but less positive interruption, but probably there is a sort of continuity by means of scattered patches of forest along the slopes of the western Andes.

In any case, it is relatively certain that the nearest geographical approach of the two forms is in this neighborhood where also the nearest approach in taxonomic characters may be expected.

There is a suggestion of *watkinsi* in some of the Pacific coast examples. A male from Seques, northwest of Pacasmayo, has the legs and feet notably pale brown, and there are suggestions of pale streaks on the mantle; there are similar suggestions in a male from Seques and a female from Palambla; the shafts of the forehead and crown also sometimes show as narrow, pale streaks, though there is not the development of streaking as present in typical *watkinsi*, which is discussed below.

Records which belong to *albiloris*, except those from localities listed with the material examined, are from Cutervo, Callacate, and Tabaconas. The new form may be distinguished as follows.

***Grallaria ruficapilla interior*, new subspecies**

TYPE from San Pedro, southeast of Iquimebamba, Perú; altitude 8600-9400 feet. No. 235,531, American Museum of Natural History. Adult male collected February 4, 1926, by Harry Watkins; original number, 10,115.

DIAGNOSIS.—Similar to *G. r. ruficapilla* of the western cordillera of northwestern Perú, but with the marginal streaks of the breast, sides, and flanks lighter and more brownish olive, without such well-defined blackish stripes separating the margins from the whitish shaft-stripes, and with the center of the breast usually less strongly marked but with the markings more frequently orange-ochraceous; whitish shaft-stripes on rump less strongly developed, narrower, and without prominent dusky borders between the central stripes and the olivaceous margins of the feathers; eye-ring broader and whiter; general color of under parts a little more strongly tinged with buffy; dusky line between lores and forehead usually heavier; rufous of head a little clearer; bill shorter and other measurements inclined to be smaller.

RANGE.—Western slopes of Central Andes of northern Perú; Subtropical Zone.

DESCRIPTION OF TYPE.—Top of head Sanford's Brown x Auburn, passing into light Brownish Olive on the back where the feathers are indistinctly margined with grayish; feathers of mantle with traces of whitish shaft-lines concealed; lower back and rump with narrow whitish shaft-stripes (not strongly bordered with dusky) not reaching the tips of the feathers; upper tail-coverts like mantle; lores white with fine, blackish tips, heaviest on upper portion where they form a dark border to the forehead; around the eye a broad whitish eye-ring; auriculars like crown, with narrow whitish bases exposed; malar region whitish with narrow blackish tips. Chin and throat whitish, tinged with pale buff; breast similarly buffy white, immaculate in middle but laterally with margins of light Buffy Brown, mixed, toward the middle of the breast, with orange-ochraceous; sides with brown margins somewhat more olivaceous and the whitish shaft-stripes narrower, obsolete on outermost feathers; flanks

with margins Light Brownish Olive separated from the broad whitish shaft-stripes by fine, not very distinct, dusky lines; abdomen and under tail-coverts white with a light buffy tinge. Wings with exposed outer surface Light Brownish Olive x Saccardo's Umber; outer webs of alula somewhat paler; under wing-coverts bright ochraceous-cinnamon; inner margins of remiges darker cinnamonaceous; tail dark Saccardo's Umber. Bill blackish (in dried skin), slightly slaty at lower base; feet dark brown. Wing, 100 mm.; tail, 56; exposed culmen, 21; culmen from base, 26.75; tarsus, 51.

REMARKS.—Female similar to male but slightly smaller. Wing, 97–100.5 mm. (av. 99); tail, 55–60 (av. 56.2); culmen from base, 26–26.75 (av. 26.5); tarsus, 50–51 (av. 50.5).

The series of ten males measures as follows: wing, 100–103.5 mm. (av. 101.5); tail, 53–64 (av. 58.6); culmen from base, 26.5–27.75 (av. 27); tarsus, 49.5–51.5 (av. 50.5).

The series of *G. n. albiloris* shows the following measurements. Males: wing, 101–108.5 mm. (av. 102.7); tail, 61–65 (av. 62.1); culmen from base, 28–30.5 (av. 29.4); tarsus, 49.5–55.25 (av. 52.4). Females: wing, 96–100 mm. (av. 98.6); tail, 59–63 (av. 60.2); culmen from base, 27–29 (av. 28.5); tarsus, 49.75–53.5 (av. 52.3). Taczanowski's measurements in the original description of the male specifies the wing, 104 mm. (later emended to 103); tail, 67 (later emended to 62); culmen, not originally given but later said to be 31; tarsus, 52. For the female: wing, 99; tail 62; culmen, 30; tarsus, 54.

Records which should be assigned to this new form are from *Tamia pampa* and "Chelo" (= Chilla), in addition to the localities given in the list of specimens examined.

***Grallaria ruficapilla watkinsi* Chapman**

Grallaria watkinsi CHAPMAN, 1919 (December), Proc. Biol. Soc. Wash., XXXII, p. 255—Milagros, Prov. Piura, Perú; ♂ ad.; Amer. Mus. Nat. Hist.

A careful study of the twenty-four available skins of this interesting bird shows such close resemblance in general respects to the various forms of *G. ruficapilla* that their relationship becomes unquestioned, though the degree of affinity is not so clear.

As noted under *G. r. albiloris*, there is in that form an occasional tendency toward *watkinsi* in lighter legs and feet and traces of pale streaks on head and back, though these are not so well developed as in typical *watkinsi*. The present bird, however, is not always uniformly distinct, and there is considerable variation, though all of the specimens examined can be identified without hesitation.

For example, a nearly adult male from Alamor, Ecuador, has no more streaking above than some *albiloris*; a female from the Río Pindo, among other skins, has the back poorly streaked but the forehead well-marked. Usually the streaks on the mantle are narrow, but three specimens from La Puente, Alamor, and Portovelo have them broader and outlined with dusky. The top of the head is usually duller and more ochraceous in tone than in *albiloris*, but an occasional specimen, like a female from Portovelo, can be matched rather closely in *albiloris*. The latero-ventral streaks are usually more strongly tinged or supplemented with orange-ochraceous, but some agree well with *albiloris*. The auriculars are rather consistently more grayish distally and more broadly whitish at the base, but there is an occasional trace of warmer color in evidence. The variations are more pronounced in the Ecuadorian birds than in the series of topotypes, possibly because the type locality is farthest removed from contact with the ranges of other forms of *ruficapilla*. In any case the differences seem to be of degree rather than of kind.

A possible conflict of ranges with *G. r. connectens* in western Ecuador has been thought to preclude the consideration of *watkinsi* as a subspecies of *G. ruficapilla*, but I believe that there is no actual conflict. All the localities from which we have *connectens* are above 5000 feet in elevation, in the true Subtropical Zone; those where *watkinsi* have been found are all below 5000 feet on the hills between the valleys of the Río Tumbes and the Río Catamayo and its affluents. Mr. H. E. Anthony, who caught some of the Ecuadorian specimens of *watkinsi* and *connectens* in his traps for small mammals, tells me that the localities of *watkinsi* were somewhat more arid in nature than those of *connectens* though still of a general subtropical aspect. The influence of the immediately adjacent Arid Tropical Zone was apparent, and some of the mammalian fauna was distinctly that of the Arid Tropics, but, on the other hand, part of the vegetation indicated the existence of continuous moisture. This hybrid zone of semiarid Subtropics, reaching from at least as low as 1850 feet and as high as 4550 feet, is the home of *watkinsi*, while the higher, more humid elevations, even on the same slopes within a few miles of the others, at least from 5350 feet to 9750 feet, within the true Subtropical Zone, are the home of *connectens*.

With these facts in evidence, I believe that the relationship of *watkinsi* to the *ruficapilla* group is best expressed by trinomials.

Up to date, *watkinsi* has been found in Perú only at Milagros and, owing to the limitations of its zonal requirements, it is not likely to appear at any great distance from this locality.

SPECIMENS EXAMINED

G. r. ruficapilla.—COLOMBIA: 8 ♂, 4 ♀, 3 (?). ECUADOR: Verdecocha, 1 ♂, 1 ♀; upper Sumaco, 2 ♂; above Baeza, 2 ♂, 1 ♀; Ambato, 2 (?); Quito, 1 (?).

G. r. avilae.—VENEZUELA: Gulipan, 2 ♂, 2 ♀; Silla de Caracas, 2 ♂.

G. r. nigro-lineata.—VENEZUELA: Valle, 3 ♂, 1 (?); Mérida, 2 ♂, 2 (?).

G. r. connectens.—ECUADOR: Taraguacocha, 3 ♂ (incl. type), 1 ♀; Celica, 2 ♂; San Bartolo, 1 ♂, 3 ♀; Guachanamá, 1 ♀; El Chiral, 1 ♀; above Zaruma (6000 ft.), 1 ♀.

G. r. waltkinsi.—PERÚ: Milagros, 5 ♂ (incl. type), 1 ♀. ECUADOR: Portovelo, 1 ♂, 4 ♀; Río Pindo, 1 ♀; La Puente, 1 ♂, 1 ♀; Alamor, 4 ♂, 4 ♀; Guainche, 2 ♂.

G. r. albiloris.—PERÚ: Seques, 4 ♂, 2 ♀; Taulis, 3 ♂; Chugur, 2 ♂, 2 ♀; Palambra, 1 ♂, 4 ♀; Huancabamba, 1 ♂; San Felipe, Río Huancabamba, 2 ♀; Hacienda Limón, 2 ♂¹.

G. r. interior.—PERÚ: Chachapoyas, 1 ♂; San Pedro, 6 ♂ (incl. type), 1 ♀; La Lejía, 3 ♂, 5 ♀; Levanto, 1 ♂; mountains east of Balsas, 1 ♂¹, 1 ♀¹.

***Grallaria macularia diversa*, new subspecies**

TYPE from Puerto Indiana, Río Amazonas (mouth of Río Napo), Perú; No. 231,935, American Museum of Natural History; adult male collected July 9, 1925, by Carlos Olalla and sons.

DIAGNOSIS.—Similar to *G. m. macularia* and *G. m. paraensis* but distinctly browner on the upper surface, less olivaceous, and with the shaft-streaks of the mantle less prominent or obsolete; tips of greater and middle upper wing-coverts less noticeably paler than the median portions and much less sharply defined; pale spot on outer webs of the primaries at their bases equally well-marked as in *macularia* and *paraensis*, but the distal portion of these webs not so strongly paler than the adjacent areas; under wing-coverts more deeply orange-ochraceous and without the dusky subterminal portions exhibited in some *macularia*; subterminal portions of pectoral feathers more strongly ochraceous; flanks browner; tail shorter than in *paraensis*, about as in *macularia*; wings variable.

RANGE.—Northeastern Perú, north of the Amazon, extending northeastward to the Cassiquiare and the region of Mt. Duida, Venezuela.

DESCRIPTION OF TYPE.—Top of head, except forehead, Deep Neutral Gray; center of forehead in midline somewhat brownish, bordered on each side by a dusky line; sides of forehead deep Ochraceous-Buff; lores paler, inclined to whitish, and with more or less prominent blackish tips which are strongest posteriorly where they form a blackish patch or line; a broad circumocular ring of Ochraceous-Orange bordered above by a narrow dusky line continuous with the blackish portion of the lores; auriculars anteriorly deep Ochraceous-Buff, with broad, dark brown tips. Back dark Medal Bronze with pale shaft-lines on middle portions concealed by the tips of the feathers. A broad, blackish stripe on upper border of malar region and another on the sides of the throat, separated by a white or buffy white stripe; center of chin and throat white; breast strongly marked with a blackish, V-shaped mark at the tip of each feather (usually not quite closed at the apex) and with the enclosed portion of the web deep ochraceous, passing into white more basad; sides similar but with the blackish markings first supplemented by olive-brown external margins which become

¹Specimens in Field Museum of Natural History, Chicago.

broad on the outer feathers while the blackish markings disappear; flanks light ochraceous-brown; belly white; under tail-coverts white tinged with ochraceous. Upper wing-coverts like back or somewhat darker, the greater and middle series with ill-defined ochraceous-tawny tips, obsolete on inner feathers; lesser series, near bend of wing, with some similar markings; longest feather of alula with entire outer web deep Ochraceous-Buff; primary-coverts blackish; primaries blackish brown with a patch of ochraceous-buff on outer web at base (except on outermost), extending about 6 mm. beyond the tips of the primary-coverts; remainder of outer webs near Sudan Brown, darker immediately following the buff basal patch but not strongly ochraceous distally; secondaries and tertiaries margined exteriorly with Brussels Brown or the color of the back; inner margins of remiges light Pinkish Cinnamon at least toward their bases; under wing-coverts tawny Ochraceous-Orange. Tail like the back. Maxilla (in dried skin) dull brown; mandible paler; feet pale brown. Wing, 86 mm.; tail, 33; exposed culmen, 18; culmen from base, 23; tarsus, 35.

REMARKS.—Females, like the males. There is some variation in the series from the region of Mt. Duida, in the direction of *macularia* as well as away from it. The nearest approach to *macularia* in the color of the mantle is shown by a female from opposite El Meroy, Río Cassiquiare, but it is still somewhat browner than either of the Guianan specimens and, in addition, shows no increase in the distinctness of the tips on the upper wing-coverts. A male from Caño León, Mt. Duida, has a slight tendency in the latter direction, but it is one of the brownest skins of the series, being Medal Bronze x Raw Umber on the mantle. A female from the same locality is even warmer. The pale patch at the base of the primaries is sometimes nearly concealed by the primary-coverts but usually is well-developed as in the type. The flanks are variable in warmth like the back, and the blackish marks of the chest are always heavy.

I was at first confident that this form would prove to be entitled to the name *diluta*, described by Hellmayr from Thomar, Rio Negro, Brazil, and later synonymized with *paraensis*, but a reexamination of the type, kindly made for me by Dr. Hellmayr, indicates the distinction of the present form. Dr. Hellmayr writes that the type of *diluta* is decidedly greenish above, like Guianan birds, with distinct, pale shaft-lines, with well-defined ochraceous-tawny tips on the upper wing-coverts, and with conspicuous pale outer margins on the apical two-thirds of the primaries. In spite of the curious distribution of the three forms as hereby indicated, the arrangement appears to be as follows: *G. m. macularia*—French and British Guiana; *G. m. paraensis*—Pará district, left bank of lower Tapajoz, right bank of upper Rio Madeira, and right bank of middle Rio Negro; *G. m. diversa*—northeastern Perú (north of the Amazon) and region of Mt. Duida, Venezuela. All these areas are

widely separated, and there is no known connection between them. Possibly some local ecological factor has determined the distribution and remains yet to be discovered.

Records from Perú are from Iquitos and Loretoyacu, the latter in territory belonging to Perú at the time of record. There is the possibility that Temminck's original description of "*Pitta macularia*" from "le Bresil," emended to "Cayenne" by Hellmayr (1910), was actually drawn up from a specimen of what is now known as *paraensis*, in which case the type locality should remain Brazil. If so, Chubb's name "*macconnelli*" would be available for the Guianan form.

Hellmayr's suggestion (Field Mus. Nat. Hist. Publ., Zool. Ser., XIII, p. 355, footn. b, 1924) that "*macularia*" might prove to be assignable to the bird Wied described as *Myioturdus ochroleucus* from Bahia, does not appear so probable. Wied's type is no longer in existence, but his description fits rather exactly a specimen at hand from Iriquy, Bahia, to which the descriptions of *Grallaria martinsi* also apply reasonably well. On the other hand, Temminck's description of *macularia* does not fit the Bahia specimen in various particulars, including its mention of a gray crown and ochraceous forehead. It seems assured, therefore, that *ochroleuca* and *martinsi* represent a species distinct from *macularia* and of doubtful affinity to specimens collected by Natterer in São Paulo and described by Hellmayr (*tom. cit.*, p. 357, footn. a).

SPECIMENS EXAMINED

G. m. macularia.—BRITISH GUIANA: Ituribisci, 1 (?); "Mines District," 1 (?).

G. m. paraensis.—BRAZIL: Rio Tapajoz, Iámoál, 1 ♂.

G. m. diversa.—PERÚ: Puerto Indiana, 1 ♂ (type). VENEZUELA: Mt. Duida, Caño León, 1 ♂, 1 ♀; Río Cassiquiare, Caño Durutomoni, 1 ♂; El Merrey, 1 ♂; opposite El Merrey, 1 ♂, 4 ♀; mouth of Río Ocamo, 1 ♂, 1 ♀.

G. ochroleuca.—BRAZIL: Bahia, Iriquy, 1 ♂.

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CORRELATION OF OSSIFEROUS SECTIONS IN THE UPPER CENOZOIC OF INDIA

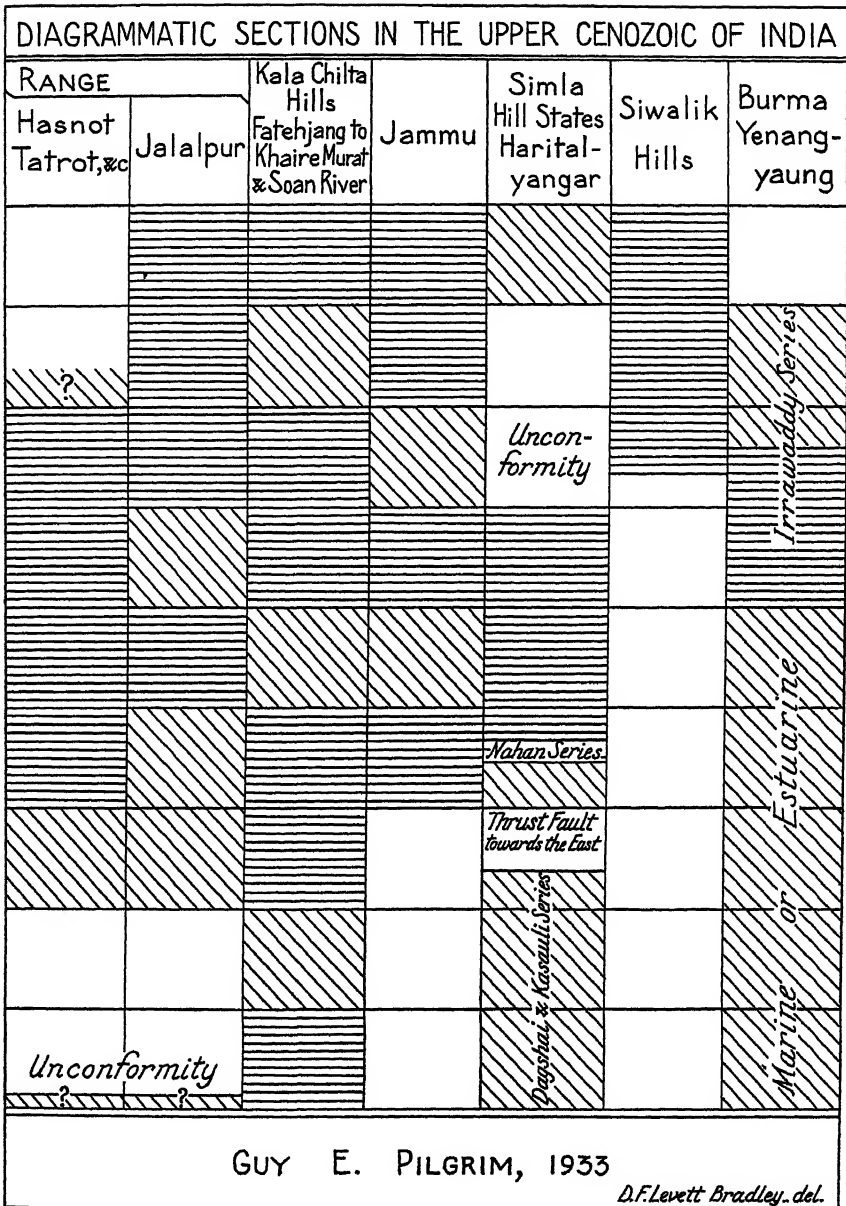
By GUY E. PILGRIM

It has been suggested to me that the facts relating to the stratigraphy of the Cenozoic Mammal deposits of India are so scattered in the literature¹ that it is difficult to form a connected idea as to how the various geological sections are correlated to one another, so as to compose in fact a complete ideal section within the period which they cover. To meet this need I have drawn up the accompanying diagram on the model of the table on page 59 of Professor H. F. Osborn's monograph on the Titanotheres,² which it is hoped will render the papers quoted more easily intelligible. The individual sections are diagrammatic, inasmuch as no indication is given of the depth of sediment comprised in each; further, although many of the sections are perfectly straightforward, with the strata dipping continuously in the same direction, yet in others simple folding exists, which does not lessen the reliability of our stratigraphical conclusions.

The correlation with the European time scale, which occupies the first column of the table, is the same as that which I have advocated elsewhere.³ I am aware that this does not find favor with certain palaeontologists, chiefly American. W. D. Matthew⁴ in particular wished not only to place the Pinjoi and Val d'Arno stages in the Pleistocene, but to assign to the Lower and Middle Siwaliks a later age than that which I consider probable. My arguments in favor of my own view are briefly stated in the above quoted paper and in the British Museum Catalogue of Pontian Carnivora (1931), pp. 151-155,⁵ and this is not the place in which to amplify them. In any case we know too little about the origin and migrations of *Hipparon*, *Equus* and *Camelus*, or what American faunas are the exact chronological equivalent of European ones, to render any opinion susceptible of precise proof. The whole question

¹See appended list of publications.
Osborn, Henry Fairfield, 1929. The Titanotheres of Ancient Wyoming, Dakota, and Nebraska. U. S. Geol. Surv. Monograph 55, p. 39.
²Pilgrim, G. E. 1932. Fossil Carnivora of India. Pal. Indica, N. S., XVIII, p. 8.
³Matthew, W. D. 1929. Critical Observations upon Siwalik Mammals. Bull. Amer. Mus. Nat. Hist., LVI, Art. VII, pp. 438, 441, 442, 445-47, 451.
⁴Pilgrim, G. E. 1931. Catalogue of the Pontian Carnivora of Europe. British Museum (Nat. Hist.), London, England.

CORRELATION OF ELEVEN TYPICAL OSSIFEROUS,					
Approximate European Equivalents	Indian Stages	Sind Bhagathoro	Baluchistan Bugti Hills	Chinji to Dhok-Pathan & Kamliak	SALT Bhaun to Nila
L. Pleistocene	Upper Siwalik <i>Boulder Conglomerate</i>	<i>Upper Manchhar Series</i>			
U. Pliocene (Val d'Arno)		<i>Pinjor</i>			
M. Pliocene (Montpellier)		<i>Tatrot</i>	<i>Unconformity</i>		
Pontian (Pikermi)	Mid. Siwalik	<i>Dhok-Pathan</i>	?		
Sarmatian (Sebastopol)		<i>Nagri</i>			
Tortonian (Grive St. Alban)	Lower Siwalik	<i>Chinji</i>			
Helvetian (Sansan)		<i>Kamliak</i>			
		<i>Murree</i>	<i>Unconformity</i>		
Burdigalian (Sables d'Orléanais)	<i>Fatehjang</i>			<i>Unconformity</i>	
				?	?
<div><div></div><div><i>Fossiliferous, containing identifiable mammalian remains</i></div></div> <div><div></div><div><i>Unfossiliferous</i></div></div>					



might be advantageously discussed at an international congress of geologists, and until a consensus of opinion is arrived at in this way, any arguments as to what position should be assigned to individual faunas seem futile.

Reliance is placed chiefly on mammal species for the correlation adopted, though lithological facies is occasionally invoked. It will be noticed over how great a geological period many of the sections extend continuously. In spite of the fact that not all parts of a section are equally fossiliferous, in some cases entirely barren, yet the zoological succession from the Lower Miocene up to the Pleistocene is perfectly clear, in a way that we perhaps find nowhere else in the world for the corresponding period. Two things only militate against a complete picture of the development or arrival on the scene of the Mammal forms of India: 1. Inadequate material; 2. The doubt as to the geological interval between any two successive species. Time will no doubt do much to minimize both these defects. The material collected by Mr. Barnum Brown in India, which has already formed the subject of many papers by himself and by Mr. E. H. Colbert, and one by myself on the Bovidae, not as yet published, seems to offer the first fruits of our extended stratigraphical knowledge, increased material, and intensive palaeontological study.

LIST OF THE MOST IMPORTANT PUBLICATIONS RELATING TO THE STRATIGRAPHY OF THE CENOZOIC MAMMAL DEPOSITS OF INDIA

- COTTER, G. DE P. 1933. The Geology of the Part of the Attock District West of Longitude $72^{\circ} 45'$. Mem. Geol. Surv. India, LV, Pt. 2, pp. 99-122, 135-136.
- FERMOR, L. I. 1932. General Report of the Geological Survey of India for the year 1931. Rec. Geol. Surv. India, LXVI, Pt. 1, pp. 118-120.
- PASCOE, E. H. 1923. General Report for 1922. Rec. Geol. Surv. India, LV, Pt. 1, pp. 40-42.
- PILGRIM, G. E. 1908. The Tertiary and Post-Tertiary Freshwater Deposits of Baluchistan and Sind, with Notices of New Vertebrates. Rec. Geol. Surv. India, XXXVII, Pt. 2, pp. 139-166.
1913. The Correlation of the Siwaliks with Mammal Horizons of Europe. Rec. Geol. Surv. India, XLIII, Pt. 4, pp. 264-326.
1917. Preliminary Note on some Recent Mammal Collections from the Basal Beds of the Siwaliks. Rec. Geol. Surv. India, XLVIII, Pt. 2, pp. 98-101.
1926. The Tertiary Formations of India, and the Interrelation of Marine and Terrestrial Deposits. Proc. Pan-Pacific Sci. Cong., Australia, 1923, pp. 896-931. (Issued 1926.)
1932. The Fossil Carnivora of India. Pal. Indica, N.S., XVIII, pp. 2-3, 6-9.
- PINFOLD, E. S. 1918. Notes on Structure and Stratigraphy in the Northwest Punjab. Rec. Geol. Surv. India, XLIX, Pt. 3, pp. 149-159.
- WADIA, D. N. 1928. The Geology of the Poonch State (Kashmir) and Adjacent Portions of the Punjab. Mem. Geol. Surv. India, LI, Pt. 2, pp. 334-362.
1932. The Tertiary Geosyncline of Northwest Punjab and the History of Quaternary Earth Movements and Drainage of the Gangetic Trough. Quar. Jour. Geol. Min. and Met. Soc. India, IV, No. 8, pp. 69-96.

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STUDIES OF AFRICAN LAND AND FRESH-WATER MOLLUSKS

3.—WEST AFRICAN *ACHATINAE* RELATED TO *ACHATINA* *BALTEATA* REEVE

BY J. BEQUAERT¹ AND W. J. CLENCH²

The West African (or Guinean) rain-forest subregion harbors a number of species of *Achatina* of a rather uniform yellowish brown to chestnut color, with or without faint chestnut or mahogany blotches. These species superficially are so similar that it is difficult to identify them from published descriptions and figures. Consequently they are frequently confused in collections and many of the published records are unreliable. Upon comparing these species, we find that each has a characteristic sculpture. This we attempt to describe in the subjoined key and notes, which, together with the enlarged photographs of the surface of the shells, should help in identifying adult specimens. It is frequently impossible to name with accuracy young shells in the absence of adults from the same colony.

Of the five species included in the key, *A. bandeirana* seemingly is restricted to Angola and the Lower Congo area; *A. rugosa* is a species of the Central and Upper Congo Basin; *A. balteata* appears to have a much wider range, extending from the mouth of the Gambia River to Benguela and the Middle Congo; *A. iostoma* is common in western Cameroon and *A. hessei* is known thus far from the type locality only. It is noteworthy that the three last-named forms occur in the same geographical and ecological area, sometimes together in one locality. This precludes regarding them as races or subspecies, though the differentiating characters are rather slight. The possibility should be considered, however, that *A. hessei* may be only an extreme variation in sculpture of *A. iostoma*.

One new subspecies, *A. rugosa chapini*, is described in this paper.

In preparing these notes, we have used, in addition to the collections of the Museum of Comparative Zoölogy (M. C. Z.), material belonging to The American Museum of Natural History (A. M. N. H.), the Academy of Natural Sciences, Philadelphia (A. N. S. P.), and the Carnegie

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²Curator of Mollusks, Museum of Comparative Zoology, Cambridge, Mass.

Museum of Pittsburgh (Carn. Mus.). We wish to thank the curators in these museums, Dr. Roy W. Miner, Dr. H. A. Pilsbry, and Dr. Stanley Brooks, for kindly sending us these specimens. All photographs, except figure 6, were made by F. P. Orchard.

- 1.—Sculpture of body whorl in adult shells consisting mainly of wavy interrupted lines, either vertical or spiral; if small beads are present, these are irregular, elongate and subordinate to the wavy sculpture. 2.
Sculpture of body whorl consisting of granular beads, arranged mainly in vertical rows; spiral lines obsolete or subordinate to the vertical arrangement of the beads. 3.
- 2.—Sculpture spiral, consisting mainly of fine wavy lines, the vertical sculpture of irregular growth-lines only *A. rugosa* Putzeys.
Wavy sculpture vertical, consisting of very fine axial lines cut at fairly regular intervals by superficial spiral lines; in addition, irregular growth-lines.
A. bandeirana Morelet.
- 3.—Beading fine, just visible with the naked eye, not felt by touch, and interrupted by many smooth or wrinkled patches; the vertical growth-lines coarser than the beads. *A. balteata* Reeve.
Beading of medium strength, quite distinct to the naked eye and well felt by touch (individual beads nearly twice as large as in *balteata*), covering the body whorl uniformly, and arranged in well-marked vertical rows; the growth-lines not coarser than the beads. *A. iostoma* Pfeiffer.
Beading very coarse, produced by deeply cut spiral and vertical furrows (individual beads about three times as large as in *balteata*).
A. hessei C. R. Boettger.

Achatina rugosa Putzeys

Figure 1

Achatina rugosa PUTZEYS, 1898, Ann. Soc. Mal. Belgique, XXXIII, Bull. Séances, p. lxxxiii, Fig. 18 (type; forest of Micici, Manyema District, Belgian Congo). DUPUIS AND PUTZEYS, 1902, Ann. Soc. Mal. Belgique, XXXVI (1901), Bull. Séances, p. lx (the type locality is here given more definitely as the forest of the Wazimba country, on the right bank of the Lualaba River, to the northeast of Nyangwe). PILSBRY, 1919, Bull. Amer. Mus. Nat. Hist., XL, p. 76 (in part; not the specimens from Ngayu, which are *A. balteata* Reeve). C. R. BOETTGER, 1927, Abh. Senckenberg. Naturf. Ges., XXXIX, part 4, p. 357.

SPECIMENS EXAMINED.—Two specimens from the Belgian Congo, without more definite locality (A. N. S. P.). Two cotypes from Micici in the Wazimba Forest near Nyangwe, Belgian Congo (one from the H. W. Winkley Collection, the other received from the Dupuis Collection now at the Musée Royal d'Histoire Naturelle, Brussels.—M. C. Z.).

All four specimens are similar in shape and appearance and may have been part of the original lot.

The sculpture of *A. rugosa* is very characteristic. It is barely noticeable with the naked eye and its true nature must be studied with a strong lens or a binocular microscope. The whole surface of the body whorl in adult shells is covered with very fine and close spiral lines, which are cut at irregular intervals by slightly raised, vertical growth-wrinkles,

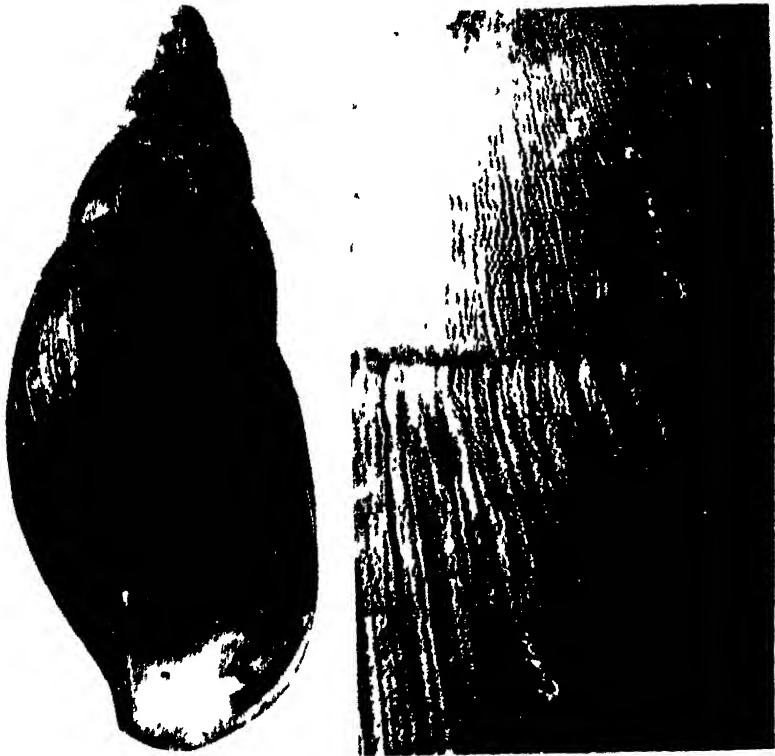


Fig. 1. *Achatina rugosa* Putzeys. Cotype, M. C. Z. No. 9296; Micici; natural size; and portion of penultimate whorl and upper half of body whorl, seen ventrally, enlarged $\times 4$.

producing a peculiar wavy appearance. In the upper half of the body whorl some of the spiral lines are thicker and divided into transversely elongate knots or welts. On the earlier whorls this knotting is more regular and more evenly distributed, so that the surface is finely granular. The columella is long and narrow, with a short basal truncation.

Putzeys' figure was based on an unusually large specimen (134 mm. long, 62 mm. wide). Our specimens are all smaller, but the proportions are the same, giving the shell a much more slender outline than any *iostoma*, *balteata* or *bandeirana* we have seen.

LENGTH	DIAMETER	APERTURE	WHORLS
111.6 mm.	47.0 mm.	60.0×27.0 mm.	8
109.8	47.5	61.0×27.0	7½
97.4	41.5	53.0×24.0	7 (Fig. 1)
96.8	40.0	52.0×22.0	7

***Achatina rugosa chapini*, new subspecies**

Figure 2

Similar to *A. rugosa* in appearance and with the same type of sculpture, but the surface more glossy and smoother, owing to the weaker growth-wrinkles. Whorls more rapidly increasing in width, and more convex, giving the shell a broader outline; the aperture also proportionately wider. Olive-ocher to colonial buff; with narrow, irregular, longitudinal, mahogany-brown stripes; sometimes also with broader chestnut-brown longitudinal blotches, more or less curved or broken up. The upper whorls are generally without blotches, more or less pinkish, and in one quite fresh specimen they are beautifully jasper pink.

LENGTH	DIAMETER	APERTURE	WHORLS
122.0 mm.	59.0 mm.	60.0×30.0 mm.	8 (holotype, Fig. 2)
104.5	52.0	59.0×27.0	7½
103.0	46.8	57.0×25.0	7½
102.0	46.0	55.0×24.0	7½
95.0	45.5	49.0×24.0	7

HOLOTYPE.—A. M. N. H. No. A6438, from Lukolela, Belgian Congo, September 1930 (J. P. Chapin).

PARATYPES.—M. C. Z. No. 93211 and A. M. N. H. No. A6438, two specimens, same data as above. M. C. Z. No. 77018, Lukolela, Belgian Congo, December 17, 1926, one specimen (J. Bequaert). M. C. Z. No. 92992 and A. N. S. P. No. 119545, five specimens, Belgian Congo, without definite locality, but possibly from Lukolela (H. Lang and J. P. Chapin.—These were part of the lot of twenty-four specimens referred by Pilsbry in 1919 to "an undescribed race of *A. rugosa*, or a closely allied species").

On the snail taken alive by the senior author many specimens of the curious wingless phorid, *Wandolleckia bififormis* Schmitz, were found running over the animal.

***Achatina bandeirana* Morelet**

Figure 3

Achatina bandeirana MORELET, 1866, Jour. de Conchyl., XIV, p. 156 (District of Pungo Andongo, Angola); 1867, 'Voy. Welwitsch, Moll. Terr. Fluv.,' (1868), p. 67, Pl. vi, fig. 1 (type; type locality here given more definitely as "Serra de Pedras de Guinga"); 1873, Jour. de Conchyl., XXI, p. 327. ANCEY, 1902, Jour. de Conchyl.,

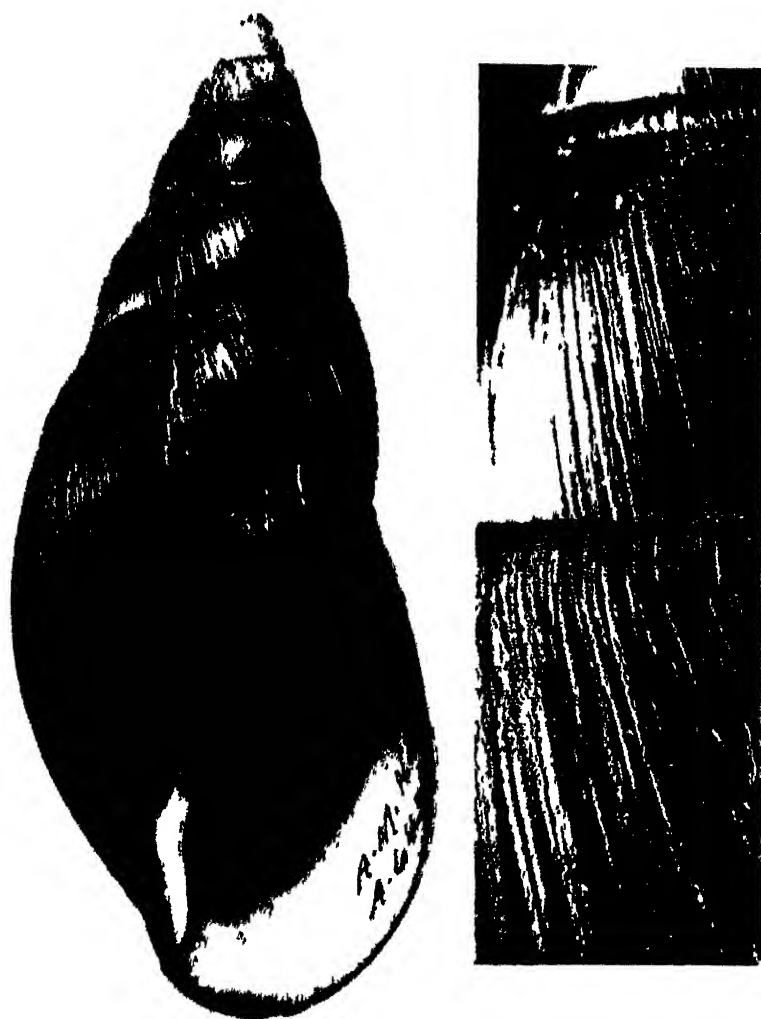


Fig. 2. *Achatina rugosa chapini*, new subspecies. Holotype, A. M. N. H. No. A6438; Lukolela; natural size; and portion of penultimate whorl and of upper half of body whorl, seen ventrally, enlarged $\times 4$.

L, p. 279. PILSBRY, 1919, Bull. Amer. Mus. Nat. Hist., XL, p. 63, Fig. 26, Pl. I, fig. 3.

Achatina bandeirana capacior C. R. BOETTGER, 1927, Abh. Senckenberg. Naturf. Ges., XXXIX, part 4, p. 356, Pl. xv, figs. 14 a-b (type; Banana, Belgian Congo).

Achatina balteata var. *infrafusca* C. R. BOETTGER, 1913, Ann. Soc. Zool. Malac. Belgique, XLVII (1912), p. 94 (specimens from Banana). Not of E von Martens, 1897.

SPECIMENS EXAMINED.—Four adult specimens from Kunga, on the Congo estuary, Belgian Congo (H. Lang and J. P. Chapin; part of the lot recorded by Pilsbry in 1919.—M. C. Z.). One adult specimen from near Kisantu, Belgian Congo (L. DeWulf.—M. C. Z.).

The peculiar sculpture of *A. bandeirana* consists, on the body whorl of adult shells, of fine and close vertical (or axial) wrinkles made wavy by numerous, superficial, spiral lines which cut them at regular intervals. Below the suture the waves are much coarser and form low, vertically elongate welts. In addition there are many moderately strong growth-wrinkles. On the earlier whorls the sculpture is more granular. The columella is broad and short, with a long basal truncation.

All the specimens we have seen, as well as those listed and figured by Pilsbry (1919), belong to C. R. Boettger's race *capacior*, which is said to be relatively shorter and broader than Morelet's type, and consequently with the body whorl wider in proportion. Boettger gave the measurements of *capacior* as: length, 104; diameter, 55; aperture, 55×30 mm.; while Morelet's type measured 101 mm. in length and 43 mm. in diameter for 8½ whorls. In our series of shells from Kunga (on the estuary of the Congo, twenty kilometers east of Banana) the proportion of length to width varies considerably, but all are bulkier on the body whorl than Morelet's figures and undoubtedly fall under the definition of *capacior*. The same is true of the specimen from Kisantu. Considering, however, that Morelet saw only two small specimens and that he later referred to *bandeirana* young specimens from Landana (a locality north of the estuary of the Congo), it seems extremely doubtful that *capacior* represents a distinct race. Until a good series of *bandeirana* can be procured from the type locality of the species, we follow Morelet, Pilsbry, and Dautzenberg in referring the shells from the Lower Congo region merely to *bandeirana*.

LENGTH	WIDTH	APERTURE	WHORLS	
115.5	56.0	57.0×32.5 mm.	8	Kisantu (Fig. 3)
141.0	71.0	72.5×37.5 mm.	Apex broken	Kunga
115.0	60.5	62.5×32.0 mm.	8	Kunga
125.5	66.5	66.5×36.0 mm.	8	Kunga

The largest specimen known, 160 mm. in length and 77 mm. in width, was found at Banza Manteka, a locality of the Lower Congo about halfway between Banana and Kisantu. It was recorded by Dautzenberg in 1891.

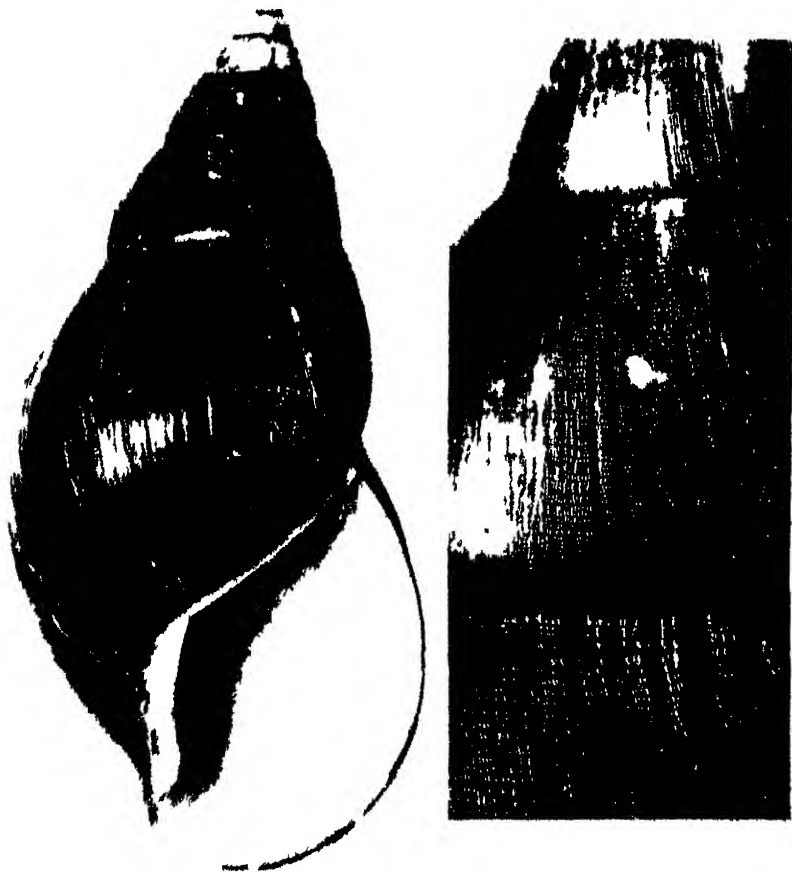


Fig. 3. *Achatina bandeirana* Morelet. M. C. Z. No. 92105; Kisantu; natural size; and portion of penultimate whorl and of upper half of body whorl, seen ventrally, enlarged about $\times 4$.

At Kisantu, Dr. L. De Wulf found phorid flies of the genus *Wandolleckia* living on *Achatina bandeirana*.

Achatina dohrniana PFEIFFER, 1870, Mal. Blätter, XVII, p. 29

("Angola"); 1870, 'Novit. Conch.,' IV, p. 1, Pl. cix, figs. 1-2 (two co-types), was claimed by H. Dohrn (1873, Mal. Blätter, XXI, p. 79) to be identical with *A. bandeirana* Morelet. This opinion, however, was disputed by Morelet (1873, Jour. de Conchyl., XXI, p. 327; 1874, *op. cit.*, XXII, p. 60), with whom we agree. The strongly concave columella and especially the rather coarse granulation extending over the lower half of the last whorl, as shown in Pfeiffer's figures, are not found in *bandeirana*. As pointed out by Morelet, *A. dohrniana* is related to *A. welwitschi* Morelet, though apparently distinct.

Achatina balteata Reeve

Figures 4 and 5

Achatina balteata REEVE, 1849 (February), 'Conch. Icon.,' V, *Achatina*, Pl. II fig. 7 (type: "Banks of the River Gambia"). PILSBRY, 1904, 'Man. of Conch.,' (2) XVII, p. 30, Pl. IV, fig. 27; 1919, Bull. Amer. Mus. Nat. Hist., XL, p. 78. GERMAIN, 1913, Bull. Mus. Nat. Hist. Paris, XIX, p. 353, fig. 71 (young shell). DAUTZENBERG, 1921, Rev. Zool. Afric., IX, part 1, p. 87.

Achatina monetaria MORELET, 1867, 'Voy. Welwitsch, Moll. Terr. Fluv.,' (1868), p. 63, Pl. VIII, fig. 2 (type: "pays de Selles, dans l'intérieur du district de Novo-Redondo, Angola").

Achatina balteata var. *vidaleti* GERMAIN, 1913, Bull. Mus. Hist. Nat. Paris, XIX, p. 354 (without definite locality, but probably from Fort Rousset, French Equatorial Africa).

Achatina rugosa PILSBRY, 1919, Bull. Amer. Mus. Nat. Hist., XL, p. 76 (in part; specimens from Ngayu, Belgian Congo). Not of Putzeys, 1898.

SPECIMENS EXAMINED.—Two specimens labelled "Gambia" (M. C. Z.). Four specimens from Bathurst, Gambia (M. C. Z. and Carn. Mus.). Five specimens from Kribi, Cameroon (G. Schwab.—M. C. Z.). Two nearly adult specimens, of 7 whorls, from Lolodorf, Cameroon (A. J. Good.—M. C. Z. and Carn. Mus.). Two specimens from Ngayu, Belgian Congo (Lang and Chapin.—A. M. N. H.) and one possibly from the same locality at the A. N. S. P.

The specimens from Ngayu were referred to *A. rugosa* Putzeys by Pilsbry, but they have the granulose sculpture of *balteata*, which is absent in true *rugosa*.

A. balteata is characterized by the peculiar, fine, granulose beading which covers all the whorls. These are described in the original description as "creberrime minute granulatis." On the upper half of the body whorl, right behind the aperture, there are 25 to 30 beads in a vertical stretch one centimeter long. The body whorl of adult shells shows no wavy sculpture, either vertical (radial) or horizontal (spiral), as is present

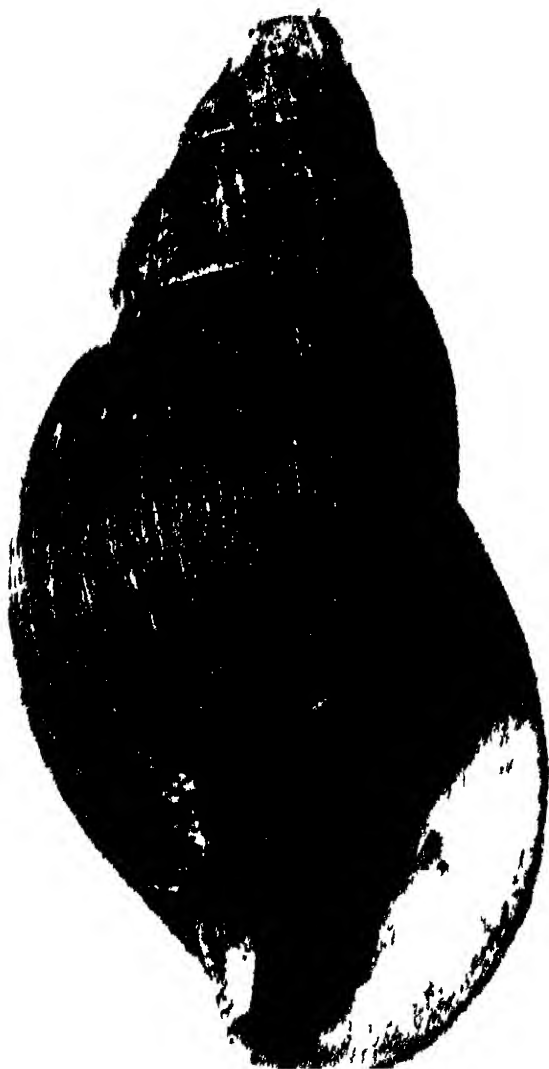


Fig. 4. *Achatina balteata* Reeve. A. M. N. H. No. 1906; Ngayu; natural size.

in *A. rugosa* and *A. bandeirana*; the beading forms incomplete short vertical rows, but it is interrupted by many smooth or irregularly wrinkled areas. In *A. iostoma* the beading is much coarser, the granules being almost twice the size of those of *A. balteata*. In *A. balteata* the beading of the earlier whorls is fairly regular; but on the last it becomes very

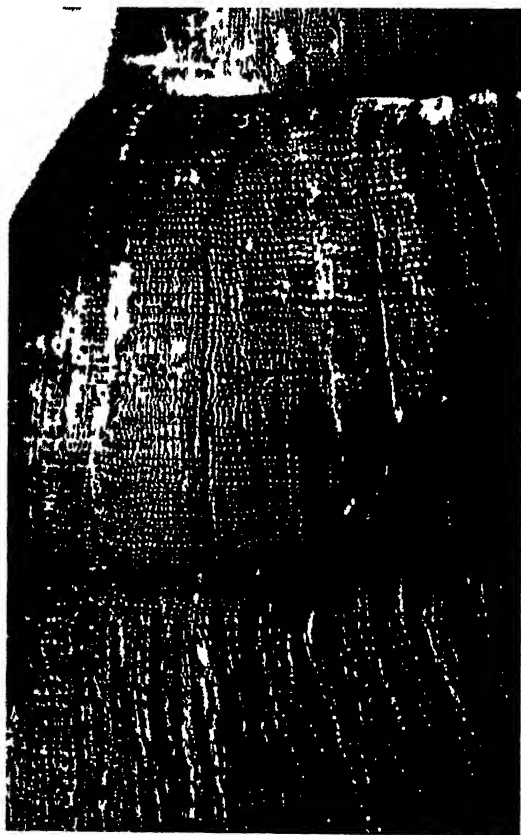


Fig. 5. *Achatina balteata* Reeve. A. M. N. H. No. 1906; Ngayu; portion of penultimate whorl and of upper third of body whorl, seen ventrally, enlarged $\times 4$.

irregular, being much distorted by the coarse growth-wrinkles. The granules are subcircular and placed in incomplete short vertical lines or strings. The arrangement of the beads in spiral chains is much less evident.

Germain's variety *vidaleti* was based upon supposedly adult specimens retaining the pale yellowish-brown color ("teinte d'un jaune marron

clair") and the violaceous columella characteristic of young shells. It does not seem possible to recognize this variety. Our largest specimen from Gambia (138 mm. long) is very pale yellowish-brown throughout, but has only faint purplish blotches on the columella. On the other hand, smaller specimens from Ngayu, while having the columella partly violaceous, are decidedly fulvous over the last two whorls. Much of the color probably depends on the freshness of the shells and on the environment where they were collected, the shells remaining darker in densely shaded spots.

Achatina monetaria, of which only the type is known, was apparently based upon an old and somewhat abnormal specimen of *A. balteata*, which Welwitsch also collected in the District of Novo-Redondo. Morelet himself appears to have been doubtful about its validity. Old or bleached specimens of Achatinidae often are heavier than usual, while abnormal specimens are frequently preserved by the natives for domestic use or as curiosities.

LENGTH	DIAMETER	APERTURE	WHORLS	
133.0	65.0	69.0 × 38.5 mm.	9	Gambia
138.0	68.0	74.0 × 40.5 mm.	9	Bathurst
120.0	60.5	61.0 × 30.5 mm.	8¾	Ngayu (Fig. 4)
114.0	57.5	64.0 × 34.5 mm.	7½	Ngayu
124.0	62.0	65.5 × 36.5 mm.	7¾	?Ngayu

Achatina balteata variety *infracusca* E. von Martens

Figure 6

Achatina dimidiata E. von Martens, 1889, 'Conch. Mitth.,' III, parts 1-2, p. 17, Pl. XLII, figs. 1-1a (type; "ad oram Fl. Gabun," French Congo). Not of E. A. Smith, 1878.

Achatina infracusca E. von Martens, 1897, 'Deutsch Ost-Afr., IV, Besch. Weichth.,' p. 89 (new name for *A. dimidiata* E. von Martens, 1889).

Achatina balteata var. *infracusca* PILSBRY, 1904, 'Man. of Conch.,' (2) XVII, p. 32, Pl. IV, figs. 22-23.

SPECIMENS EXAMINED.—One specimen from Lukolela, Belgian Congo (J. P. Chapin.—A. M. N. H.). Four specimens from the Gaboon (M. C. Z. and A. N. S. P.). Two specimens from Lambarene on the Ogowe River, Gaboon (Mrs. L. Russell.—A. N. S. P.).

This variety is characterized by the pronounced, more or less wavy, chestnut stripes which extend over all the whorls, but are lacking on the lower half of the last whorl. In the typical form, only the early whorls have a few vertical chestnut blotches. Moreover, as Pilsbry has pointed out, there are transitional specimens. It has been claimed that *infra-*

fusca has also a proportionately shorter and broader shell than typical *balteata*; but this is not borne out by E. von Martens' measurements of the type of *infracusca* (length, 120; width, 60; aperture, 59×32 mm.), nor by specimens we have seen.

According to Dr. J. P. Chapin's notes, the living specimen which he photographed at Lukolela (Fig. 6) had the dorsal surface of the extended



Fig. 6. Living *Achatina balteata* var. *infracusca* E. von Martens. Lukolela. Photograph by J. P. Chapin.

animal behind the shell light yellowish-gray, shading to blackish on head and tentacles.

The variety *infracusca* does not seem to be geographically segregated and is hardly worth retaining. Among the specimens listed above from Bathurst, Gambia, one is intermediate between the typical coloration and the variety *infracusca*, having on the body whorl a series of chestnut streaks faintly confluent at the periphery into a spiral band which becomes more pronounced behind the outer lip.

LENGTH	WIDTH	APERTURE	WHORLS	
152.0	68.5	75.0×37.0 mm.	9	Lukolela (Fig. 6)
137.5	70.0	70.0×39.0 mm.	9	Gaboon
116.0	61.0	63.0×31.5 mm.	Apex broken	Lambarene

Achatina iostoma Pfeiffer

Figure 7

Achatina iostoma PFEIFFER, 1854, Proc. Zool. Soc. London, (1852), p. 86 (Fernando Po); 1867, 'Conch.-Cab.,' I, Abt. 13, part 1, p. 360, Pl. XLIII, fig. 7 (type from the Cuming Collection). PILSBRY, 1904, 'Man. of Conch.,' (2) XVII, p. 32, Pl. xvii, fig. 18, and Pl. XLII, fig. 10.

Callistoplepa tiara PRESTON, 1900, Ann. Mag. Nat. Hist., (5) VI, p. 183, Pl. vi, fig. 9 (type; Bitye [misspelled Bitze], near the River Ja, Cameroon).

Achatina gruweli DAUTZENBERG, 1921, Rev. Zool. Afric., IX, p. 91, Pl. vi, figs. 1-2 (type; Yaunde, Cameroon, at 780 m. altitude).

SPECIMENS EXAMINED.—Two adult shells from Elalawa (Elat), Cameroon (A. N. S. P.). One adult and six young shells from Yaunde, Cameroon (A. N. S. P.; M. C. Z.). Two adult shells from Metet, Cameroon (A. J. Good.—M. C. Z.). One adult shell from Bipindi, Cameroon (A. J. Good.—Carn. Mus.). One adult shell from Efulen, Cameroon (A. N. S. P.).

Although originally described from the Cuming Collection as coming from Fernando Po, *A. iostoma* has never again been taken on that island and the type locality is extremely doubtful. The species is known with certainty from western Cameroon only, where it is common in many localities.

A. iostoma is readily distinguished from *A. balteata* by the much coarser, very tangible, beaded sculpture, which covers more uniformly the entire surface of the shell. The beads are placed in regular spiral and slightly confluent, vertical rows over the entire width of the body whorl. Some eighteen to twenty beads may be counted on the upper half of the body whorl, right behind the aperture, in a vertical stretch of one centimeter.

LENGTH	WIDTH	APERTURE	WHORLS	
126.0	61.0	68.0×34.5 mm.	8	Metet (Fig. 7)
125.5	59.0	69.0×32.5 mm.	8	Metet
119.0	60.0	68.0×34.0 mm.	8	Elalawa
117.0	55.5	72.0×31.0 mm.	8	Elalawa
126.0	64.5	67.0×36.5 mm.	8	Yaunde

As pointed out by Dupuis [1923, Ann. Soc. Zool. Belgique, LIII (1922), p. 81], *Callistoplepa tiara* Preston was based upon a young *Achatina*. We do not hesitate in referring it to *A. iostoma*. We have before



Fig. 7. *Achatina iostoma* Pfeffer. M. C. Z. No. 81963; Metet; natural size; and portion of penultimate whorl and of upper half of body whorl, seen ventrally, enlarged about $\times 4$.

us a young shell of that species (55 mm. long, of 6 whorls), from Yaunde, which agrees in every detail with Preston's description and figure. Bitye is on the Ja River, about seventy miles to the southeast of Yaunde.

Some of our specimens of *A. iostoma* agree in every respect with Dautzenberg's figures and description of his *A. gruehi*, which, in our opinion, was based upon young specimens of *iostoma* (95 mm. long, of 7 whorls). As yet we have seen no true cotypes of *gruehi*; but specimens referred to that species at the A. N. S. P. (some of them apparently named by Dautzenberg) are certainly young *iostoma*. They have the "hydrophanous" streaks mentioned by Dautzenberg for *gruehi*; but such streaks are often present in true *iostoma*, as well as in related species (for instance, in *A. bandeirana*).

Achatina hessei C. R. Boettger

Achatina hessei C. R. BOETTGER, 1913, Proc. Malac. Soc. London, X, part 6, p. 350, Pl. xvii, fig. 1 (type; "Yaunde, southern Cameroons").

Achatina iostoma DAUTZENBERG, 1921, Rev. Zool. Afric., IX, p. 89. Not of Pfeffer, 1854.

We are as yet unable to understand this species, which is known only from the type locality. So far as can be gathered from the description, Boettger saw only one specimen. He compared his new species with *A. balteata*, but made no reference to *A. iostoma*.

At the A. N. S. P. there are, under the name *A. hessei*, four dead, very poorly preserved specimens from Yaunde, Cameroon, received from P. Hesse, and labelled "topotypes; part of original lot." There is, however, no evidence that they were ever seen by Boettger. In these specimens the beading is decidedly coarser than in *A. iostoma* of approximately the same size and from the same locality. A young specimen, with similar very coarse sculpture, was sent from the southern Cameroon by G. Schwab (M. C. Z. No. 72306); we refer it provisionally to *A. hessei*.

Additional material may prove that *A. hessei* merely represents an extreme variation in sculpture of *A. iostoma*.

The shells from Yaunde, which Dautzenberg referred to *iostoma*, possibly may have been *hessei*, the description of which he seems to have overlooked. He states that "Son test est beaucoup plus mince que celui de l'*A. balteata*; la surface des derniers tours est entièrement couverte de granulations beaucoup plus fortes et disposées en séries longitudinales irrégulières qui bifurquent, puis se rejoignent et forment ainsi, par places, des losanges allongés. La spire s'élargit aussi plus

rapidement que chez l'*A. balteata* et le dernier tour, plus haut en proportion, est aussi plus ventru." Most of these peculiarities agree better with *A. hessei* than with *A. iostoma*. Moreover, we believe that Dautzenberg redescribed the true *A. iostoma*, in the same paper, as *A. gruveli*.

REACTIONS OF *DROSOPHILA* TO 2537Å RADIATION

BY FRANK E. LUTZ AND E. N. GRISEWOOD

Many insects react to at least the longer wave-lengths of ultraviolet light as though they see them quite clearly. Kühn and Pohl (1921, Naturwiss., IX, p. 738) trained the honey-bee, *Apis*, to come to certain ultraviolet wave-lengths for food, and Lutz (1923, Amer. Mus. Novitates, No. 641) showed that another bee, *Trigona*, distinguished between ultraviolet patterns, one of which marked the nest-site.

Bertholf has published several very careful pieces of work on this subject. One (1931, Jour. Agric. Research, XLIII, p. 703) concerned *Apis*. In it he gives a curve of the "stimulative efficiency" of light from a "Uviarc" lamp giving radiation from about 2800 to about 7000 Å. This curve has a low peak near 5500 and a high one in the ultraviolet at 3650 Å. Light from the mercury-vapor arc was dispersed by a spectroscopic and brought to focus on a piece of ground quartz. "Visible light" from an incandescent electric lamp illuminated a piece of ground glass, the intensity of illumination being controlled by the experimenter. Bees, put into an otherwise dark box, tended to go to whichever of these illuminated windows seemed brightest to them. An intensity of white light was found such that the bees went about equally to it and to the window of ground quartz illuminated by that one of the spectral lines which was being investigated. Knowing the relative intensity of the white light and the energy of the spectral band (after it had passed through the ground quartz?), Bertholf obtained a coefficient of the "relative stimulative efficiency" of the spectral band. However, the energy from the source used dropped off at 2800 Å to a quantity too small to be measured by a thermopile and galvanometer. It is not strange, therefore, that 2800 Å did not show any relative stimulative efficiency. This leaves open the question as to how far into the ultraviolet this bee can see.

In a subsequent paper (1932, Zeit. f. vergl. Physiologie, XVIII, p. 32) Bertholf used the same experimental method with a fly, *Drosophila melanogaster*. In this case the source of ultraviolet had slight but measurable energy in radiation as short as 2380 Å. He states that the energy at 2350 Å was "too small to measure" and that the relative

stimulative effect there was "very slight if any." In view of the difficulty of transmitting through air radiation of shorter wave-lengths than about 2500 Å, it is indeed surprising that the flies showed any response. Going up the scale toward longer waves, a maximum efficiency was found at about 3650 Å. There was, however, an indication of a minor peak at about 2540, probably the band near 2537 Å, the one which we used in the experiments described in this paper. It is possible that this peak was due, at least in part, to the fact that his source of ultraviolet had a "relative energy" of 7.3 there as compared with 0.9 at 2480 and with 1.8 at 2800 Å. It is also possible that, were we able to transmit through air a reasonable amount of radiation shorter than 2300 Å we might find that insects react to it as well.

Our experiments with the same fly, *Drosophila melanogaster*, dealt solely with the 2537 line, using a different experimental method. They confirm Bertholf's findings as to the fact that the fly reacts to this radiation. The apparatus used was as follows:

A cold quartz-mercury arc was focused by a quartz condensing lens on the slit of a small quartz spectrograph (Hilger type E 37). The rear aperture of the spectrograph was covered with a black cardboard, in which a narrow slit passed the 2537 line but no others.

The specimens were put into a glass tube 5 cm. long with an internal diameter of about 4 mm. Each end of the tube was fitted with removable quartz windows approximately 2 mm. thick. A black cardboard mask was placed between each window and the tube. Each mask had a hole fitting exactly the bore of the tube, and the outer edges of each mask extended well beyond the outside of the tube, thus preventing light from entering the tube except at the ends of the bore.

The tube was mounted on a leveling table back of the spectrograph. Adjustment to 2537 was checked at both ends of the tube by means of a fluorescent glass. The 2537 line was made sufficiently high to fill the tube vertically, but it was barely half a millimeter wide where it entered the left-hand end of the tube and only about 3 mm. wide at the other end. Owing to the small size of *Drosophila*, it was easily possible for such a fly to rest in parts of the tube with its eyes entirely out of the 2537 radiation.

Long-wave radiation, visible to man, was obtained from an incandescent electric light focused through an f 4.5 camera lens. In the work reported here a 100-watt "spot-light" was used. The filament was focused about 10 cm. in front of the right-hand end of the specimen tube so that the light entered the tube as a diverging beam, completely filling it. Stray light was largely prevented by the housing of the lamp.

Threads, one centimeter apart, were tied around the tube, marking off five divisions that are referred to here as I (the centimeter nearest the source of the short-wave radiation), II, III, IV, and V (the centimeter nearest the source of the long-wave radiation).

In order to observe the actions of the flies at all times, a small microscope lamp was hung about 50 cms. above the specimen tube. The window of this lamp was ground glass and for this work was covered with a red filter of such a density that a fly could barely be seen in the tube when other lights were off. The ventilation holes of this lamp permitted some light to escape toward the ceiling of the room. Also, since the mercury arc was not completely enclosed, stray light from it was diffused about the room when the arc was running. Scattered light from these sources was very weak and generally distributed. However, the I end of the specimen tube was close to the black screen of the spectrograph, and the V end was pointed toward the open room. The slight tendency of the flies to favor the V end may have been due to this weak scattered light in the room. If so, it would tend to counteract any "attractive" effect the 2537 radiation might have had. An attempt has been made in the analysis of the results to neutralize this possible source of error.

Reflections within the tube and fluorescence of it should also be kept in mind. The long-wave radiation, filling the tube, was in part reflected from its sides at a slight angle. Some was reflected directly backward from the quartz window at the I end. On the other hand, the 2537 beam did not nearly fill the tube until close to the V end, where some was probably reflected backward by the quartz window there. Where the 2537 beam struck the glass tube, it set up an exceedingly faint fluorescence noticeable to us only when the red light was off, and our eyes were completely dark-adapted. It was slightly more intense but very limited in area at the I end; more diffuse at the V end. If these reflections and fluorescence had any effect on the actions of the flies, they probably tended to decrease the apparent effectiveness of the 2537 beam and to increase the apparent effectiveness of the light visible to us.

A record was kept of the division of the tube in which the fly was at each second of the experiment. This was done by means of a typewriter and a metronome beating seconds. Five typewriter keys in a row were taken to represent the five divisions of the tube. At each beat of the metronome that key which corresponded to the division occupied by the fly was pressed.

Five conditions of illumination were considered: "Dr," darkness except for the red light and such other light as was scattered from its ventilation holes; "Dra," both the red light and the mercury arc going but the ultraviolet components of the beam coming through the condenser lens cut off from the spectrograph by two sheets of glass (total thickness, 4 mm.) placed between the lens and the slit; "Lr," long-wave light entering the V end of the tube and the red light on; "Sra," the 2537 beam entering the I end of the tube and the red light and, of course, the arc on; and "SLra," a combination of Lr and Sra.

In the fifteen experiments summarized in Table I, each fly was subjected for one minute to each of these conditions of illumination in the sequence, Dr, Lr, Dr, Sra, Dra, SLra, the cycle being run five times in as quick succession as possible. In this way Lr was checked by the Dr both before and after it, while Dra served as a check on the immediately preceding Sra and the immediately following SLra.

The flies used were bred and kept in the dark-room. The transferring of a fly from the breeding jar to the observation tube was done quickly in illumination from an incandescent lamp, and then the tube was left in Dr for several minutes before starting the experiment. This delay gave the fly time to quiet down somewhat and also to regain what dark-adaptedness it might have lost during the transfer. Usually the flies kept up a fair state of activity in the tube for several hours—much longer than was required—but a few individuals were inclined to remain quietly in one place, particularly at one end or the other of the tube. Several very inactive flies were discarded entirely, but otherwise those noted are not selected individuals.

BEHAVIOR IN "DARKNESS"

If the position of a fly in the tube were a purely random matter, we might expect an equal number of records for each division. However, owing to the presence of a window at each end, there was a greater area over which the fly could walk in I and in V than in either II, III, or IV. In accord with this, it will be noticed that the flies were in each of the end divisions more than in any of the intermediate ones. The middle division, III, was favored by the fact that the flies must go through it when moving from the two divisions at either end to the other.

However, I plus II would be expected to equal IV plus V unless there was something particularly attractive at one end or the other. Combining the records of all fifteen flies, out of the 8940 seconds in Dr the flies spent 3414 in I and II and 3719 in IV and V. This is in the

proportion of 0.48 to 0.52. The difference from the expected (on the basis of chance) proportion of 0.50 each is not very significant but should be kept in mind. In the case of Dra the proportions are 1621 to 2047 or 0.44 to 0.56, clearly significant differences from 0.50 each.

Since everything about the tube itself was the same during the Dr and the Dra runs for individual flies, it is probable that the slight favoring of the IV+V end of the tube when only the red light was on and the stronger favoring when the arc also was burning are to be explained as the effect of stray light from these sources being reflected from the walls of the room into that end of the tube. As is to be expected on the basis of chance and because of variability in the sensitiveness of flies, this bias in favor of the IV+V end of the tube is not apparent in the case of every individual fly. So far as it existed it would increase the apparent effectiveness of the long-wave radiation and decrease the apparent effectiveness of the 2537 beam.

BEHAVIOR IN LONG-WAVE RADIATION

The "visible light" as it entered the V end of the tube had an intensity of 120 foot candles. The fly could easily be seen in this illumination, but, for the sake of uniformity, the red light (with a little scattered light from the lamp's ventilation holes) was kept on. Table I gives the record for 4500 seconds. This is reduced in Table II to terms of the percentages of time spent in I+II: III: IV+V, giving 30, 12, and 58. The corresponding percentages during Dr were 38, 20, and 42. Subtracting the latter from the former shows the shift caused by long-wave radiation entering the V end of the tube. It gives -8 for I+II, -8 for III, and +16 for IV+V. The increase in the two-fifths of the tube nearest the source of long-wave light is clearly significant. That normal *Drosophila melanogaster* goes toward light visible to us is not news. The data are given here for the sake of comparison with the fly's reactions to 2537Å.

BEHAVIOR IN 2537Å

The beam of 2537Å radiation as it struck the outer face of the quartz window on the I end of the tube had an intensity of 8 microwatts per sq. cm. This radiation is well beyond the ultraviolet region usually considered in biological work. Significantly shorter wave-lengths than this (until X-rays¹ are reached) are so fully absorbed by air that they can be well transmitted only in a vacuum. In fact, even 2537 is absent from sunlight at moderate altitudes. Since it is probable that atmos-

¹So far as we know, the conclusion of Axenfeld (1896, Centralblatt Physiologie, X, p. 436) that photopositive insects react to X-rays has not been disproved. This should be retested, carefully guarding against possible errors caused by fluorescence.

pheric conditions in past geologic ages were even less favorable for its transmission, there is no reason to believe that insects have ever encountered it in nature.

Table I shows that when the 2537 line entered the tube (Sra) the flies spent 2920 out of 4500 seconds in the two centimeters at that end of the tube (I+II). This is 65 per cent of the time and is to be contrasted with Dra during which all of the conditions were the same except that 4 mm. of plain glass prevented the 2537 radiation from entering the spectrograph. In Dra the flies spent 1621 out of 4500 seconds in the two centimeters at the spectrograph end of the tube. This is only 36 per cent of the time. The difference between Sra and Dra is 29 per cent, making it quite clear that the 2537 radiation has a marked effect on the flies' behavior.

This effect of 2537 is all the more striking when it is noted that, with the possible exception of fly 18;3 (see Table III and the accompanying footnote), no individual fly responded with a difference in I+II of less than 11 between Sra and Dra, while four of them had a difference between Lr and Dr (proportionate time spent in IV+V) of less than 11. The average difference between IV+V in Lr and the same in Dr was only 16 as compared with 29 for Sra and Dra. Furthermore, as was pointed out before, the beam of 2537 covered only about an eighth of the horizontal diameter of the tube at the spectrograph end, leaving considerable space dark. Had we been able to fill the tube completely with 2537 light, the effect would probably have been even more evident.

LONG-WAVE IN COMPETITION WITH 2537 RADIATION

In this part of the experiment (SLra) long-wave light entered the V end of the tube and 2537 entered the I end. The 4500 seconds were divided in the proportions of 47:11:42 among I+II, III, and IV+V, respectively (see Table IV). The difference in proportions between the two ends is only 5. However, this does not take into account the favoring of the V end in Dra. If we subtract from the proportions in SLra the proportions in Dra, we get +11, -8, and -3. While these numbers are too small to permit a very definite statement, the indications are that, as used in these experiments, the 2537 beam of about 8 microwatts per sq. cm. was sufficiently "attractive" to this photopositive insect to more than balance the "attractiveness" of the 120 foot candles white light visible to us.

Since the intensity of the long-wave radiation, measured by a calibrated photronic cell and microammeter, is given in foot candle power,

and the intensity of the 2537 radiation, measured by a thermopile, is given in microwatts per sq. cm., they are not comparable. Where "white light" is used, the statement of its intensity in terms of total energy does not seem entirely justified because, even if infrared is filtered out, there remain in white light a large number of bands which do not have equal effectiveness per unit of energy, and their relative effectiveness, comparing one with another, varies with the intensity. The only certain way would seem to be the using of monochromatic light in the long-wave as well as in the short-wave region. This was not attempted in the present work.

So far as we have been able to recognize them, all uncertain factors, such as the number of times the flies got out of the narrow beam of 2537 radiation and the effect of reflections within the tube, tended to decrease the apparent effectiveness of the 2537 radiation. Therefore, we believe that its real effectiveness must be even greater than our data indicate.

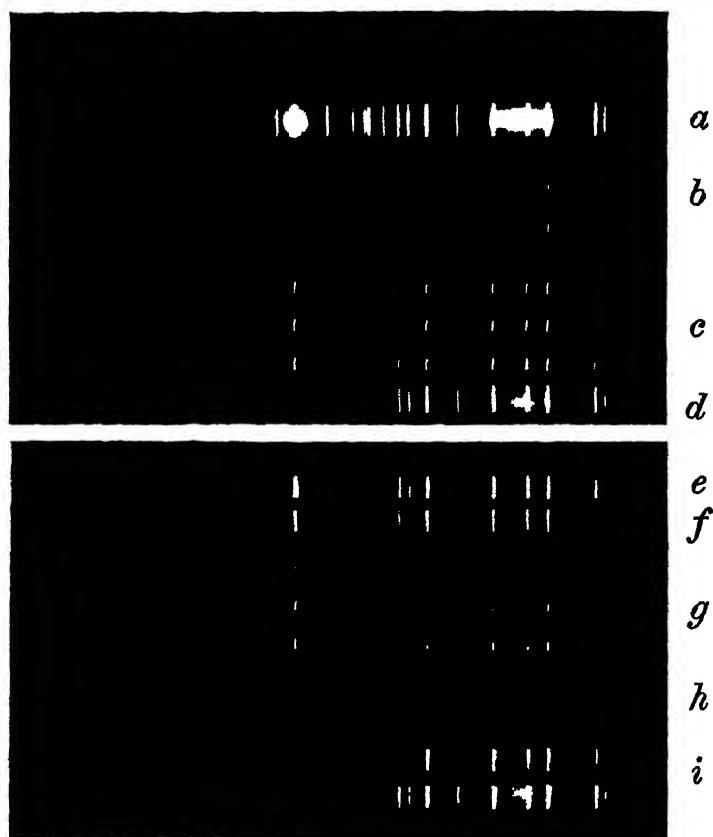
DO THE FLIES SEE 2537Å RADIATION ?

Granted that *Drosophila* behaves as though it sees the 2537 beam, there is still a possibility that it does not actually see such light directly but that the 2537 radiation sets up a fluorescence in the fly's eye and that the fly reacts to the presence of this fluorescence. Such a fluorescence, if present, might have a wave-length or wave-lengths greater than 4000 and, so, be in our visual range or it might be in the near ultraviolet. In the latter case the fly would still be directly seeing ultraviolet but not such an extremely short wave-length.

Before radiation can reach the sensitive parts of an insect's eye it must pass through a hard outer layer, the cornea. Unfortunately, mounting the cornea of a *Drosophila* eye so that a spectrogram could be made of the radiation transmitted by it did not seem feasible. We did, however, make spectrograms of the radiation transmitted by the cornea of a large flesh-fly (*Sarcophaga*) and by that of the hive-bee (*Apis*). Figure 1 shows that not only does the cornea of each of these very dissimilar insects transmit all of the ultraviolet bands of the source used but that it is distinctly more transparent to the extremely short wave (2537) than is even cellophane approximately 0.025 mm. thick.¹

¹The unpigmented cuticula of the third abdominal tergum of the bee was found to transmit rather fully the near ultraviolet, but only very faintly the 2537. The pigmented cuticula of the thorax of the *Sarcophaga* did not transmit either. For further and more detailed information concerning fluorescence in insect eyes and the permeability of insect exoskeletons to ultraviolet light, see, for example, Merkens,

Drosophila, but the regularity of Bertholf's curve and the fact that there was no change in the type of the fly's reactions when offered 2537 indicate that we are really dealing with vision. A wingless race, notably unreacting to light, did not, so far as our experiments went, react to 2537.



j

Fig. 1.—Spectrograms of: *a*, the arc direct, 15 secs.; *b*, the arc through the exoskeleton of the dorsum of the abdomen of *Apis*, 15, 30, and 60 secs.; *c*, the arc through the cornea of *Apis*, 15, 30, and 60 secs.; *d*, the arc through cellophane, 15 secs.; *e*, the arc direct, 15 secs.; *f*, the arc through quartz, 15 secs.; *g*, the arc through the cornea of *Sarcophaga*, 15, 30, and 60 secs.; *h*, the arc through the exoskeleton of the dorsum of the thorax of *Sarcophaga*, 15 and 30 secs. (no transmission); *i*, the arc through cellophane, 15 and 60 secs. The 2537Å line is seen at *j*.

This being true, it follows that not only does the 2537 radiation reach the inner elements of the eye but also that it probably causes no fluorescence on the cornea. Fluorescence can not be set up unless energy is absorbed, and our plates show neither such absorption nor fluorescent bands.

Even so, it might be possible that fluorescence is produced within the eye, and that this fluorescence, rather than direct 2537 radiation, affects the optic nerves. When we let the 2537 beam fall on a mass of crushed *Drosophila* eyes we could detect no fluorescence. While this does not disprove the presence of fluorescence, it would seem to indicate that, if there be any in our visual range, it is very faint—apparently much too faint to more than counterbalance the long-wave light from the incandescent lamp in the SLra experiments. If fluorescence be present but be of ultraviolet wave-length, we come back to the conclusion that these insects see ultraviolet.

It was thought that possibly some evidence on this subject might be obtained by experiments in light-fatigue. If we can not fatigue the fly's eyes to 2537 without affecting its reactions to wave-lengths greater than 4000 and vice versa, the explanation of the failure might be either (1) that the fly's eyes can not readily be fatigued in the wave-length tried or (2) that the fly does not see 2537 directly but as a fluorescence in the long waves, and, so, in attempting to fatigue it to 2537 we are really fatiguing it in light of longer waves. On the other hand, if it can be done, it would indicate that the fly sees 2537 directly, although there is a possible objection that the phenomenon is still one of fluorescence but that there is a fluorescence in a narrow band of wave-lengths and that we are fatiguing to that narrow band in contrast to the wide range of wave-lengths in light visible to us.

In experiment 20;1 a female was subjected for nearly three-quarters of an hour to a constant counterillumination (SLra) of 2537 and the long-wave light used in previous experiments. In Table V the record is divided into four consecutive periods. Remembering that the I+II end of the tube is the one toward the source of 2537, it will be noted that at first the fly went with increasing faithfulness to that end and then fell off to a considerable extent. This may indicate that the fly's eyes were at first more fatigued to the long waves, giving 2537 a greater effectiveness, and then became fatigued to 2537, more nearly equalizing the two. Possibly, even, long exposure to 2537 was destroying some receptive element in the fly's eyes.

Table VI summarizes a series of experiments, in each of which a fly bred in darkness was tested for 200 seconds in SL1a, then subjected to either Lr or Sra for five minutes and again tested in SLra.

Let us consider first the five flies that were given Lr. Three of the five went less to the V end of the tube or, putting it the other way, more to the I end after they were subjected to the Lr than before. The opposite was true of the other two, but, on the whole there was a slight, but possibly significant shift in favor of Sra as though the five minutes in Lr had fatigued the flies to the long waves.

Considering the five flies that were given Sra, three showed a decided shift in favor of Lr. The other two showed no significant shift either way. On the whole, what may have been fatiguing to definite wavelengths seems to have been more marked in the case of Sra than in that of Lr.

The results of these experiments with light-fatigue are certainly not clear-cut enough to be very satisfactory. Possibly the fatiguing periods were not long enough, especially in view of the fact that for considerable portions of these periods the flies were not facing the light and that, in the case of the 2537 beam, the flies could get entirely out of it. However, while urging the desirability of further work on this problem, we do feel that the indications are that the 2537Å radiation has a physiological effect on the fly's eyes distinct from that of long light waves, just as the physiological effect on our eyes of blue is distinct from that of red, suggesting a distinct receptive mechanism. In other words, normal *Drosophila melanogaster* can see 2537Å radiation directly and was not reacting to an indirect effect of it. If this be true, it has some interesting bearings on biological speculation in view of the fact that light of so short a wave-length does not and probably never did occur in the environment of insects.

TABLE I.—Data from main experiments.

	Dr					Dra					Lr					Sra					SLra				
	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
15;1 ♂	146	154	108	82	110	65	63	79	38	55	54	37	28	52	129	171	41	46	21	21	85	53	30	42	90
15;2 ♂	71	87	128	107	147	52	58	36	84	70	58	30	28	36	148	167	23	28	35	47	74	50	29	34	113
17;1 ♂	125	75	111	81	208	40	49	50	45	116	39	29	73	31	128	180	28	26	20	46	102	23	24	26	125
18;1 ♀	162	99	103	98	138	77	52	51	43	77	79	35	27	16	143	135	58	39	29	29	83	46	33	44	94
18;2 ♀	150	87	90	88	185	75	57	47	30	91	55	29	27	32	157	140	38	43	30	49	107	40	29	58	66
18;3 ♀	84	95	172	128	121	67	68	57	50	58	50	40	42	43	125	103 ³ 45 ³	44 ³	39 ³	65 ³		85	44	53	39	79
18;4 ♀	135	98	110	118	139	47	34	38	59	122	71	44	51	42	92	218	24	21	13	24	123	44	42	37	54
18;5 ♀	123	97	107	112	161	52	45	54	56	93	54	37	51	47	111	184	38	28	26	24	118	41	33	28	80
19;1 ♂	139	86	107	87	181	64	33	40	47	116	74	40	44	34	108	205	28	19	18	30	64	34	31	29	142
19;2 ♂	141	85	128	103	143	51	27	65	66	91	46	26	30	38	160	169	30	37	25	39	104	40	39	38	79
19;3 ♂	84	129	185	120	82	24	53	115	63	45	32	28	35	47	158	125	37	42	47	49	73	42	39	39	107
24;2 ♂	152	101	104	121	122	75	42	47	47	89	43	17	31	32	177	201	36	22	24	17	105	33	27	20	115
24;3 ♂	168	90	122	108	122	58	35	45	45	117	81	36	31	31	121	130	27	29	43	71	109	31	37	32	91
24;4 ♂	182	86	104	84	144	74	50	44	42	90	23	59	35	44	139	115	42	34	28	81	121	39	36	33	71
26;2 ♀	129	64	128	113	166	90	44	64	44	58	64	30	32	38	136	131	51	38	29	51	134	50	31	24	61
Total	1981	1433	1807	1550	2169	911	710	832	759	1288	823	517	565	563	2032	2374	546	496	437	647	1487	610	513	523	1367

15;1 had trouble in walking.

Only 9 minutes of Dr recorded.

15;2 of the one-minute runs with Sra thus fly "rested" for 34 seconds in the V section. Omitting this minute, the other four make the score I, 98, II, 44; III, 31; IV, 32; V, 33.

TABLE II.—Data, reduced to percentages, showing the reaction to “visible” light

	Lr			Dr			Lr-Dr		
	I, II	III	IV, V	I, II	III	IV, V	I, II	III	IV, V
15;1, ♂	30	9	60	50	18	32	—20	— 9	28
15;2, ♂	29	9	61	29	24	47	0	—15	14
17;1, ♂	23	24	53	33	19	48	—10	5	5
18;1, ♀	38	9	53	44	17	39	— 6	— 8	14
18;2, ♀	28	9	63	40	15	46	—12	— 6	17
18;3, ♀	30	14	56	30	29	42	0	—15	14
18;4, ♀	38	17	45	39	18	43	— 1	— 1	2
18;5, ♀	30	17	53	37	18	46	— 7	— 1	7
19;1, ♂	38	15	47	38	18	45	0	— 3	2
19;2, ♂	24	10	66	38	21	41	—14	—11	25
19;3, ♂	20	12	68	36	31	34	—16	—19	34
24;2, ♂	20	10	70	42	17	41	—22	— 7	29
24;3, ♂	39	10	51	41	20	38	— 2	—10	13
24;4, ♂	27	12	61	44	17	38	—17	— 5	23
26;2, ♀	31	11	58	32	21	47	— 1	—10	11
Averages	30	12	58	38	20	42	—8	—8	16

TABLE III.—Data, reduced to percentages, showing the reaction to 2537Å.

	Sra			Dra			Sra-Dra		
	I, II	III	IV, V	I, II	III	IV, V	I, II	III	IV, V
15;1, ♂	71	15	14	43	26	31	28	—11	—17
15;2, ♂	63	9	27	37	12	52	26	— 3	—25
17;1, ♂	69	9	22	30	17	54	39	— 8	—32
18;1, ♀	64	13	23	43	17	40	21	— 4	—17
18;2, ♀	59	14	26	44	16	40	15	— 2	—14
18;3, ♀ ¹	49	15	36	45	19	36	4	— 4	0
18;4, ♀	81	7	12	27	13	60	54	— 6	—48
18;5, ♀	74	9	17	32	18	50	42	— 9	—33
19;1, ♂	78	6	16	32	13	54	46	— 7	—38
19;2, ♂	66	12	21	26	22	52	40	—10	—31
19;3, ♂	54	14	32	26	38	36	28	—24	— 4
24;2, ♂	79	7	14	39	16	45	40	— 9	—31
24;3, ♂	52	10	38	31	15	54	21	— 5	—16
24;4, ♂	52	11	36	41	15	44	11	— 4	— 8
26;2, ♀	61	13	27	45	21	34	16	— 8	— 7
Averages	65	11	24	36	19	45	29	—8	—21

¹See footnote to Table 1. The revised scores would give the proportions in Sra, 59, 13, 28, and make Sra-Dra 14. This probably more nearly represents the reaction of the fly.

TABLE IV.—Data, reduced to percentages, showing the reaction when “visible” was opposed to 2537Å light.

	SLra			SLra-Dra		
	I, II	III	IV, V	I, II	III	IV, V
15;1, ♂	46	10	44	3	—16	13
15;2, ♂	41	10	49	4	— 2	— 3
17;1, ♂	42	8	50	12	— 9	— 4
18;1, ♀	43	11	46	0	— 6	6
18;2, ♀	49	10	41	5	— 6	1
18;3, ♀	43	18	39	— 2	— 1	3
18;4, ♀	56	14	30	29	1	—30
18;5, ♀	53	11	36	21	— 7	—14
19;1, ♂	33	10	57	1	— 3	3
19;2, ♂	48	13	39	22	— 9	— 3
19;3, ♂	38	13	49	12	—25	13
24;2, ♂	46	9	45	7	— 7	0
24;3, ♂	47	12	41	16	— 3	—13
24;4, ♂	53	12	35	12	— 3	— 9
26;2, ♀	61	10	28	16	—11	6
Averages	47	11	42	11	— 8	— 3

TABLE V.—Data from the experiment in which a fly (20;1) was kept in opposing lights for 2400 seconds.

	I+II	III	IV+V	I+II/IV+V
First Period	276	77	247	1 12
Second Period	301	63	236	1 28
Third Period	375	57	168	2.23
Fourth Period	309	49	242	1.28

TABLE VI.—Data from the attempts to induce differential fatigue of the flies' eyes.

	SLra (200 seconds following darkness)			SLra (200 seconds following 5 minutes of Lr)			Second SLra minus the first		
	I, II	III	IV, V	I, II	III	IV, V	I, II	III	IV, V
23;1, ♂	96	21	83	116	19	65	20	— 2	—18
23;3, ♀	101	30	69	110	21	69	9	— 9	0
30;1, ♀	85	28	87	85	17	98	0	—11	11
30;4, ♀	75	26	99	89	26	85	14	0	—14
31;1, ♀	74	23	103	75	30	95	1	7	— 8
Total	431	128	441	475	113	412	44	—15	—29

	SLra (200 seconds following darkness)			SLra (200 seconds following 5 minutes of Sra)			Second SLra minus the first		
	I, II	III	IV, V	I, II	III	IV, V	I, II	III	IV, V
23;2, ♂	82	23	95	80	26	94	— 2	3	— 1
29;1, ♂	95	24	81	49	16	135	—46	— 8	54
30;2, ♂	83	33	84	75	20	105	— 8	—13	21
30;3, ♂	92	28	80	74	31	95	—18	3	15
31;2, ♂	70	22	108	75	19	106	5	— 3	— 2
Total	422	130	448	353	112	535	—69	—18	87

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NOTES ON AMERICAN CRAB SPIDERS (THOMISIDAE)

By W. J. GERTSCH

Most of the common crab spiders of the United States were described by Keyserling in the first volume of his magnificent work on American spiders, 'Die Spinnen Amerikas,' published in 1880. In spite of the clear-cut descriptions and the good figures, many forms have been redescribed subsequently and are still known by these later names. Many of the changes in specific nomenclature proposed in the following pages are directly due to a reconsideration of Keyserling's species. A study of practically all the types of the Thomisidae that are deposited in Museums in the United States has cleared up the identity of many obscure species and has aided in placing those described during the last decade. Only those species are mentioned in which some important taxonomical change has been deemed necessary. In addition, a few forms have been regarded as new and are described in this paper.

The specific identity of many of our American spiders with European species is well known. Through the courtesy of Dr. E. Schenkel of Switzerland and M. L. Fage of France, nearly forty species of European Thomisidae have been made available to me for comparison with spiders of the family from the United States. While in the main the study has served to verify previous identifications, some other species have been added to the list and their synonymies noted. A study of the European *Coriarachne depressa* shows that the American species are fully congeneric and are not referable to a distinct generic category. *Platyrysticus* becomes a synonym of *Coriarachne*. The following list is doubtless far from complete and many other species may well be expected to be endemic to both the Nearctic and Palearctic regions.

- Philodromus aureolus* (Olivier), 1789, (*P. canadensis* Emerton, 1917).
Philodromus rufus Walckenaer, 1825, (*P. pictus* Emerton, 1892).
Philodromus alascensis Keyserling, 1883, (*P. varians* Kulczynski, 1908).
Thanatus coloradensis Keyserling, 1880, (*T. alpinus* Kulczynski, 1887).
Thanatus formicinus (Olivier), 1789, "Greenland."
Tibellus oblongus (Walckenaer), 1802, (not *T. duttoni* Hentz, 1847).
Tibellus maritimus (Menge), 1874, (*T. oblongus* Simon, not auct.).
Misumena calycina (Linnaeus), 1758, (*M. vatia* Clerck, 1757).

THOMISIDAE

Xysticus C. Koch

Xysticus verecundus, new species

Figures 1 and 2

MALE.—Total length, 3.46 mm. Carapace black, with only a faint indication of a lighter median longitudinal band, completely lacking any lateral or marginal stripes and markings. Eye tubercles black. Sternum, labium, maxillae, basal leg joints and the femora and patellae of the first two pairs of legs black. Tibiae basally darkened, the remainder of that joint and the distal ones brownish. The last two pairs of legs maculate in black and white, the femora nearly black, the metatarsi and tarsi yellowish brown. Abdomen showing no pattern, nearly black, with a few lighter round maculations.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1 73	46	80	36	.46	1 66 mm.
Width	1 73	93	76	.26	.26	1 63 mm.

Eye rows recurved, the first narrower than the second in the ratio 36:40. Ratio of the eyes: ALE:AME:PLE:PME=7:4:5:3. Anterior median eyes separated by about two diameters, half as far from the much larger laterals. Posterior median eyes separated by nearly three diameters, much farther from the laterals (8/12). Median ocular quadrangle very slightly broader in front, as long as broad, the anterior eyes slightly larger and scarcely two diameters from the clypeal margin.

The first two pairs of legs equal in length, the last two approximately so, all heavily spined, the first two tibiae with 1-2-2-2 beneath, the metatarsi, 2-2-2.

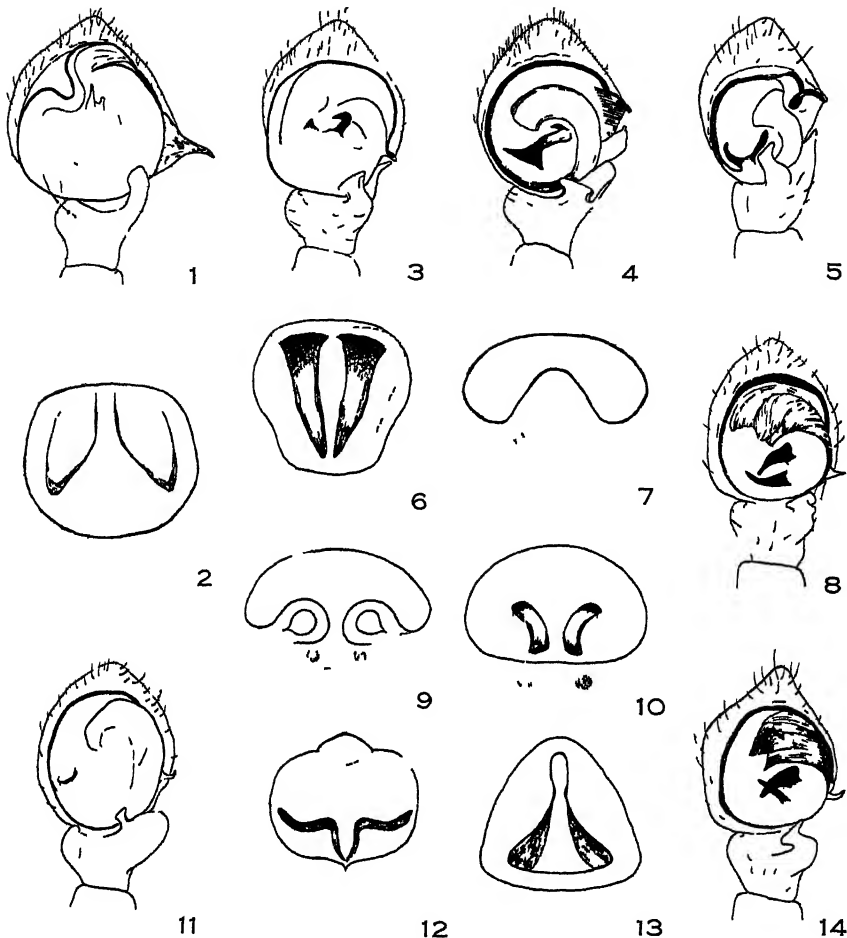
	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1 60	76	1 16	1 10	76	5 38 mm.
II	1.60	76	1.16	1 10	76	5 38 mm.
III	1 10	.46	.83	.56	.53	3 48 mm.
IV	1.10	46	.83	.66	56	3.61 mm.

Ratio of coxae I: II: III: IV = 1.7: 1.6: 1.4: 1.5.

Femur of male palpus about as long as the patella and tibia taken together, a little shorter than the tarsus. Tibia completely lacking the customary prolateral apophysis, the ventral one a moderately stout spur curved laterad. Tarsus about as broad as long, the bulbal elements simple, lacking the lower apophysis, the upper one gone or represented by a small fold. Embolus a fine tube on the prolateral side, terminating in the groove delimited by the conspicuous, laterally directed tutaculum.

FEMALE.—Total length, 5.83 mm. Integument of carapace dull yellow, the sides dark brown, the median longitudinal light band, which is as broad as the first eye row, somewhat invaded by brown streaks and spots. Eye region white in front, the posterior medians in a brown field. Sternum, labium, and legs dull yellow, infuscated and maculate with black. Legs with a pale dorsal median streak, otherwise heavily marked above in black, lighter beneath. Abdomen light brown, the irregular black markings forming the pattern arranged in the caudal half in indistinct transverse bars, the venter a little lighter.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2.53	.60	1 16	.56	.73	3 40 mm.
Width	2.53	1.56	.96	.40	.33	3.46 mm.



PALPI AND EPIGYNA

- Figs. 1. and 2. *Xysticus verecundus*, new species.
 Fig. 3. *Xysticus pretiosus*, new species.
 Fig. 4. *Xysticus quinquepunctatus* Keyserling.
 Fig. 5. *Xysticus variabilis* Keyserling.
 Fig. 6. *Xysticus brücheri*, new species.
 Fig. 7. *Xysticus lassanus* Chamberlin.
 Fig. 8. *Xysticus texanus* Banks.
 Fig. 9. *Xysticus lutulentus*, new species.
 Fig. 10. *Xysticus discursans* Keyserling.
 Fig. 11. *Xysticus hesperus*, new species.
 Fig. 12. *Oxyphila okefinokensis*, new species.
 Fig. 13. *Xysticus concursus*, new species.
 Fig. 14. *Xysticus laticeps* Bryant.

Eye rows recurved, the first narrower than the second in the ratio 52: 60. Ratio of the eyes: ALE: AME: PLE: PME = 8: 5: 6.5: 5. Anterior median eyes separated by fully three diameters, half as far from the much larger laterals. Posterior median eyes separated by almost three diameters, a little farther from the lateral (18/15). Median ocular quadrangle as broad in front as behind, broader than long (24/20), the anterior eyes two diameters from the clypeal margin.

Legs as in the male, the fourth very slightly longer than the third, heavily spined, the first two tibiae with 1-2-2-2, the metatarsi with 2-2-2-2 beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.33	1.23	1.73	1.60	.90	7.79 mm.
II	2.33	1.23	1.73	1.60	.90	7.79 mm.
III	1.60	.70	1.03	.83	.66	4.82 mm.
IV	1.60	.70	1.13	1.00	.66	5.09 mm.

Ratio of coxae I: II: III: IV = 2.4: 2.4: 2.3: 2.3.

Epigynum as figured.

TYPE LOCALITY.—Male holotype, female allotype, and female paratype from Lake Chapala, Jalisco, Mexico (L. H. Weld, collector), the types in the Cornell collection and the female paratype in the collection of The American Museum of Natural History.

Xysticus quinquepunctatus Keyserling

Figure 4

Xysticus quinquepunctatus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 28, Pl. I, fig. 12.

MALE.—Total length, 3.80 mm. Cephalothorax provided with the customary long spines in the eye region and on the clypeal margin. Carapace with a broad median longitudinal light band nearly one-third as broad as the carapace, enclosing a V-shaped light maculation that begins at the black marking of the median cephalic suture and runs forward to the eyes. Sides of the carapace dark brown. Sternum creamy white, brown-flecked, the labium and endites darker. Femora, patellae, and a small part of the tibiae of the first two pairs of legs dark brown, the distal joints yellow or light brown, the last two pairs of legs heavily maculate in black and white, the tarsi and metatarsi lighter. Abdomen creamy white above, with three transverse black bands behind and a few basal spots, the venter irrorate in black.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.86	.53	.86	.33	.50	2.00 mm.
Width	1.86	1.00	.76	.26	.26	2.00 mm.

Eye rows recurved, the first narrower than the second in the ratio 40: 45. Ratio of the eyes: ALE: AME: PLE: PME = 8: 4.5: 5.5: 4. Anterior median eyes separated by two diameters, little more than half as far from the larger laterals. Posterior median eyes separated by two and one-half diameters, three diameters from the laterals. Median ocular quadrangle a little broader than long, almost imperceptibly broader in front than behind (18/17.5). Clypeus scarcely twice as high as the diameter of an anterior median eye.

Legs all heavily spined, the anterior tibiae with 2-2-2-2, the metatarsi with 2-2-2-2 spines beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.93	.86	1.40	1.66	.86	6.71 mm.
II	1.93	.86	1.40	1.66	.86	6.71 mm.
III	1.33	.56	.83	.80	.53	4.05 mm.
IV	1.33	.56	.93	.83	.60	4.25 mm.

Ratio of coxae I: II: III: IV = 1.9: 1.8: 1.7: 1.7.

Male palpus closely related to those of *Xysticus cunctator* Thorell and *X. pallidus* Bryant and separable from the latter with some difficulty. The median bulbal apophysis is turned more toward the prolateral margin than in that species and the details of the apical sclerite are slightly different.

FEMALE.—Total length, 5.30 mm. Carapace with a white stripe that is as broad as the first row of eyes, invaded by black dots in the anterior half and with a small black maculation at the median cephalic furrow. Sides of the carapace brown. Sternum, labium and endites white, punctate in black. First three pairs of legs white, regularly punctate in black, the last pair with larger maculations on the femora, patella and tibiae. Abdomen white, with three pairs of very small spots above.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.80	.60	.83	.33	.50	3.50 mm.
Width	1.73	1.00	.66	.26	.26	3.50 mm.

Eye rows recurved, the first narrower than the second in the ratio 39:45. Ratio of the eyes: ALE: AME: PLE: PME = 7: 4: 5.5: 4. Anterior median eyes separated by a little more than two diameters, half as far from the larger laterals. Posterior median eyes separated by little over two diameters, scarcely three diameters from the laterals. Median ocular quadrangle broader than long (9/8) as broad behind as in front. Clypeus as high as twice the diameter of an anterior median eye.

The anterior two legs with 1-2-2-2 spines beneath the tibiae and 2-2-2-2 beneath the metatarsi.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.60	.76	1.08	1.06	.66	5.14 mm.
II	1.60	.76	1.06	1.06	.66	5.14 mm.
III	1.00	.60	.66	.60	.50	3.36 mm.
IV	1.00	.60	.83	.73	.60	3.76 mm.

Ratio of coxae I: II: III: IV = 1.8: 1.7: 1.5: 1.5.

LOCALITIES.—Elsinore, Utah (Clear Creek Canyon) (male and female), June 15, 1930 (Gertsch); Claremont, California (males); Castleford, Idaho (female); Monroe Canyon, Utah (female); Montpelier, Idaho (male); Medicine Hat, Alberta (females).

Xysticus canadensis, new name

Oxyptila cinerea EMERTON, 1892, Trans. Connecticut Acad. Arts and Sci., VIII, p. 366, Pl. XXIX, fig. 6 (not *X. cinereus* C. L. Koch, 1837; not *Thomisus cinereus* Blackwall, 1861).

Xysticus pretiosus, new species

Figure 3

MALE.—Total length, 3.30 mm. Carapace with a median longitudinal light stripe, about a third as wide as the carapace, that is narrowed somewhat at the cephalic suture and encloses the characteristic creamy white V-shaped maculation, the broad band anteriorly much invaded by light-brown markings. Sides of the carapace brown but with much of the lighter integumental color showing through. Sternum heavily maculate with reddish brown, the labium and endites lighter. Femora of legs heavily marmorate with reddish brown, the distal joints yellowish, the distal joints of the last two pairs of legs irregularly maculate. Abdomen dark reddish-brown, with three broken transverse black bands in the caudal half.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.80	.50	.80	.30	.46	1.93 mm.
Width	1.73	1.00	.60	.20	.20	1.80 mm.

Eye rows recurved, the first narrower than the second in the ratio 38:42. Ratio of the eyes: ALE: AME: PLE: PME=8.5: 5: 6: 5.5. Anterior median eyes separated by one and one-half diameters, half as far from the larger laterals. Posterior median eyes separated by about one and one-half diameters, slightly more than two diameters from the laterals. Median ocular quadrangle very slightly longer than broad, the eyes subequal. Clypeus scarcely twice as high as the diameter of an anterior median eye.

Legs heavily spinose, the anterior tibiae with 1-2-2-2, the metatarsi with 2-2-2 spines beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.66	.70	1.33	1.20	.80	5.69 mm.
II	1.66	.70	1.33	1.20	.80	5.69 mm.
III	1.26	.50	.86	.66	.63	3.91 mm.
IV	1.33	.50	.90	.83	.66	4.22 mm.

Ratio of coxae I: II: III: IV=1.6: 1.6: 1.4: 1.5.

The palpus is immediately separable from all other American species by the anterior position of the bulbal apophyses. The species is somewhat reminiscent of *Xysticus auctifcus* Keyserling but is easily separated by the palpi and color characteristics.

TYPE LOCALITY.—Male holotype from Forest Grove, Clear Co., California, August. Male paratypes from near Roseberg, Oregon, August 30, 1931 (W. Ivie), Terrace, British Columbia, July 1931 (W. Hippishley, collector). The holotype is in the collection of The American Museum of Natural History.

Xysticus hesperus, new species

Figure 11

MALE.—Total length, 5.00 mm. Cephalothorax heavily spinose throughout, the spines of the eye region and clypeal margin much longer and more robust. Carapace dark reddish-brown on the sides, the median longitudinal pale band yellowish and about as wide as the interval between the anterior lateral eyes. Sternum, labium and endites dark reddish-brown. Tarsi and metatarsi of the legs yellow, the

basal joints dark reddish-brown, with a few lighter integumental markings showing through. Abdomen dark reddish-brown above, caudally with transverse black bars, white on the sides, the venter brown.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2.33	.56	1.13	.46	.70	2.76 mm.
Width	2.43	1.33	1.00	.40	.33	2.33 mm.

Eye rows recurved, the first narrower than the second in the ratio 48: 54. Ratio of the eyes: ALE: AME: PLE: PME=9: 4: 6: 4. Anterior median eyes separated by about three diameters, half as far from the larger laterals. Posterior median eyes separated by about three diameters, a little farther from the laterals. Median ocular quadrangle broader than long (21/17) approximately equal in width before and behind, the anterior medians about two diameters from the clypeal margin.

Legs heavily spinose, the anterior tibiae and metatarsi with 2-2-2-2 spines beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.00	1.13	1.56	1.70	.96	7.35 mm.
II	2.00	1.13	1.56	1.70	.96	7.35 mm.
III	1.33	.76	1.00	.93	.66	4.68 mm.
IV	1.33	.76	1.00	.93	.66	4.68 mm.

Ratio of coxae I: II: III: IV=2.3: 2.2: 2.0: 2.0.

Palpus practically identical with that of *Xysticus montanensis* Keyserling, of which this may be only a giant race. The bulb is without the conspicuous apophyses that are present in most of the species of the genus. The female is 6.70 mm. long and agrees in structural characteristics with the male and with the female of *montanensis*. In Keyserling's description of *discursans* two species are confused, the male which is to be regarded as the type of that species and a female that is either identical with *hesperus* or possibly *triangulosus* Emerton.

TYPE LOCALITY.—Male holotype from Atherton, California, female allotype from Los Angeles, California. Female paratypes from Claremont, California, Santa Cruz Island, California, Salt Lake City, Utah, and Ferron, Utah. Male and female paratypes from Corvallis, Oregon, December. Types in the collection of The American Museum of Natural History.

***Xysticus peninsulanus*, new species**

MALE.—Total length, 3.66 mm. Carapace pure black except for a median and narrower lateral brownish streaks caudally, the eye region with a broken, transverse light line between the eye rows. Sternum light brown, sparsely punctate in black, the labium, endites, and first coxae black, the third and fourth coxae light brown and with a round black marking near the base. Femora, patellae and base of tibiae of first two pairs of legs black, the distal joints progressively lighter, the last two legs light brown and sparsely marked with black spots. Abdomen dark brown to black and showing transverse black bands caudally that are margined in white, the venter paler.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2.00	.43	.86	.36	.53	1 83 mm.
Width	1.83	1.10	.66	.30	.30	1.50 mm.

Eye rows recurved, the first narrower than the second in the ratio 47: 52. Ratio of the eyes: ALE: AME: PLE: PME=7: 4.5: 6: 4.5. Anterior median eyes separated by two and one-half diameters, half as far from the laterals. Posterior median eyes separated by about three diameters, the same distance from the laterals. Median ocular quadrangle much broader than long (21/12), the anterior median eye little more than a diameter from the clypeal margin.

Legs heavily spinose, the anterior tibiae 2-2-2-2 beneath (the first proximal spines single under the first leg), the metatarsi 2-2-2 beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.73	.83	1.33	1.26	.76	5.91 mm.
II	1.73	.83	1.33	1.26	.76	5.91 mm.
III	1.06	.53	.73	.56	.43	3.31 mm.
IV	1.06	.53	.76	.63	.43	3.41 mm.

Male palpus practically identical with that of *Xysticus acquiescens* Emerton but differing in the shorter, lower apophysis on the bulb. Emerton's species, however, has a much higher clypeus, is correspondingly higher throughout the carapace, and has the medium ocular quadrangle narrower in front. The spines on *acquiescens* are also quite different, being 2-2-2-2 beneath the metatarsi and 2-2-2-2-2 beneath the tibiae.

TYPE LOCALITY.—Male holotype from Punta Gorda, Florida, in the collection of The American Museum of Natural History.

Xysticus lutulentus, new species

Figure 9

FEMALE.—Total length, 5.83 mm. Cephalothorax provided with many short spines throughout, the clypeal margin with longer ones. Carapace dark brown on the sides and provided with a median longitudinal light stripe as broad as the interval between the lateral eyes of the first row, the band anteriorly much invaded by brown markings. Sternum light, the labium, endites, and coxae brown with white markings. Legs lightest distally, the basal joints with light and dark streaks above, the femora marmorate in white and black. Abdomen cleared, showing no pattern.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2.60	.63	1.06	.50	.76	3 33 mm.
Width	2.60	1.56	1.00	.33	.33	3.33 mm.

Eye rows recurved, the first narrower than the second in the ratio 44: 55. Ratio of eyes: ALE: AME: PLE: PME=7.5: 5: 6: 5. Anterior median eyes separated by two diameters, little more than half as far from the laterals. Posterior median eyes separated by two diameters, scarcely three diameters from the laterals. Median ocular quadrangle as broad as long, equilateral. Clypeus twice as high as the diameter of an anterior median eye.

Legs heavily spinose, the first tibia with 1-2-2-2 spines beneath, the second with 2-2-2, the metatarsi with 2-2-2-2 beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.43	1.26	1.86	1.80	.93	8.28 mm.
II	2.43	1.26	1.86	1.80	.93	8.28 mm.
III	1.66	.73	1.00	1.00	.56	4.95 mm.
IV	1.66	.76	1.26	1.16	.70	5.54 mm.

Epigynum about as broad as long, completely lacking the median septum characteristic of many species. The figure is sufficient to distinguish it from all other known American species.

TYPE LOCALITY.—Female holotype from Tillamook County, Oregon, August, 1932 (R. W. Macy, collector), deposited in the collection of The American Museum of Natural History.

Two females of this species are in the collection of the Museum of Comparative Zoölogy that are labelled *Xysticus borealis* Keyserling. A study of Keyserling's description seems to show that there is no good basis for such a disposition, in spite of the fact that they are from Alaska and resemble superficially the species in question.

Xysticus concursus, new species

Figure 13

FEMALE.—Total length, 5.40 mm. Carapace gray to white, with a well-marked median longitudinal light band as wide as the first eye row, that is invaded by a large central gray maculation. Sides and clypeus brown. Integument of the legs nearly white, over which is superimposed a heavy covering of tiny gray spots and flecks. Abdomen gray, with transverse light bands made up of white spots.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2.37	.80	1.00	.43	.54	3.62 mm.
Width	2.50	1.42	.75	.30	.32	4.00 mm.

Eye rows recurved, the first narrower than the second in the ratio 47: 60. Ratio of the eyes: ALE: AME: PLE: PME=8: 5: 6: 5. Anterior median eyes separated by two and one-half times their diameter, five-eighths as far from the laterals. Eyes of the posterior row equidistantly spaced. Median ocular quadrangle slightly broader than long (6/5), narrower in front in the same ratio. Clypeus twice as high as the diameter of an anterior median eye.

The first two pairs of legs equal in length, the last two approximately so, the first two tibiae with 2-2-2 spines beneath, the metatarsi with 2-2-2-2.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.80	1.26	1.66	1.66	.87	8.25 mm.
II	2.80	1.26	1.66	1.66	.87	8.25 mm.
III	1.46	.76	.90	.90	.56	4.58 mm.
IV	1.60	.76	1.13	1.10	.66	5.25 mm.

Epigynum as figured.

TYPE LOCALITY.—Female holotype from Edinburgh, Texas, collected by Mr. Stanley Mulaik and deposited in the collection of The American Museum of Natural History through his generosity.

This small species resembles *Xysticus gulosus* Keyserling and *X. ontariensis* Emerton in structure and coloration. In addition to the obviously different epigynum as a basis for its separation from these forms, *X. concursus* has only three pairs of spines beneath the first tibia.

***Xysticus britcheri*, new species**

Figure 6

FEMALE.—Total length, 5.00 mm. Carapace light brown to gray, with lateral brown bands and a median longitudinal light stripe in which are three white streaks. Under side of the carapace light brown, irregularly flecked with red. Legs light brown, with median and lateral creamy white narrow longitudinal stripes on the femora, patellae and tibiae, the femora with a pale stripe beneath. Abdomen light brown, with white side bands and a median broader light stripe, caudally with three white bands.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2 33	.66	1.16	.46	.66	3.33 mm.
Width	2 16	1.40	.76	.33	.33	3.00 mm.

Eye rows recurved, the first narrower than the second in the ratio 37:43. Ratio of the eyes: ALE: AME: PLE: PME=10: 5: 7: 5. Anterior median eyes about twice as far from each other as their distance to the laterals. Eyes of the posterior row equidistantly spaced. Median ocular quadrangle slightly broader than long (23/21), narrowed in front in the same ratio. Clypeus equal in height to two diameters of an anterior median eye, armed on the margin with nine robust spines.

First two pairs of legs equal in length, the tibia of the first with 2-2-2-2 spines beneath, the second 2-2-2-2, the metatarsi with 2-2-2-2 beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2 90	1 56	2 16	2 10	1 00	9 72 mm.
II	2 90	1 56	2.16	2 10	1 00	9 72 mm.
III	2 06	1.06	1 30	1 06	.76	6 25 mm.
IV	2 26	1.06	1.50	1.26	.80	6 88 mm.

Epigynum characterized by the presence of a pair of heavily sclerotized, black, tubular ridges that are nearly as long as and almost completely fill the atrial cavity.

TYPE LOCALITY.—Female holotype from Onondaga County, November 3 (Britcher collection).

This species is apparently related to such forms as *Xysticus acquiescens* Emerton, *X. cinereus* Emerton and others in which the atrial cavity is prominently ridged. It differs from the species enumerated above in being more elongate and less flattened. The size and position of the tubular ridges in the atrium of the genital organ are characteristic.

***Xysticus auctifiscus* Keyserling**

Xysticus auctifiscus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 25, Pl. I, fig. 10.

Xysticus trimaculatus BRYANT, 1933, Bull. Mus. Comp. Zool., LXXIV, pp. 179-180, Pl. II, figs. 12 and 13.

This fine species is found in several of the midwestern and southern states, where it appears not to be uncommon. It was described from Colorado and is often cited as a typical western form. However, I have never seen a specimen from the region west of Colorado.

***Xysticus cunctator* Thorell**

Xysticus cunctator THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 494.

Xysticus lenis KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 27, Pl. I, fig. 11.

Xysticus californicus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 37, Pl. I, fig. 17.

Xysticus ancistrophor CHAMBERLIN AND GERTSCH, 1929, Pomona College Jour. Ent. and Zool., XXI, pp. 4-5, fig. 10.

This is the commonest western species of *Xysticus*. It has also been reported from several states east of the Rocky Mountains. The records from Florida, however, are almost certainly erroneous. Structurally it is closely allied to *X. ferox* (Hentz), *X. banksi* Bryant and *X. quinque-punctatus* Keyserling.

***Xysticus funestus* Keyserling**

Xysticus funestus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 10, Pl. I, fig. 2.

Xysticus brunneus BANKS, 1892, Proc. Acad. Nat. Sci., Philadelphia, p. 53, Pl. III, fig. 4.

Xysticus crudeli BANKS, 1892, idem, p. 53, Pl. III, fig. 5.

Xysticus nervosus BANKS, 1892, idem, p. 55, Pl. III, fig. 8, Pl. IV, fig. 84.

***Xysticus discursans* Keyserling**

Figure 10

Xysticus discursans KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 20, Pl. I, fig. 7 (not female).

Xysticus vernalis BRYANT, 1930, Psyche, XXXVII, p. 139, figs. 13 and 15.

***Xysticus ferox* (Hentz)**

Thomisus ferox HENTZ, 1847, Jour. Boston Soc. Nat. Hist., V, p. 445, Pl. XXIII, fig. 3.

Xysticus stomachosus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 7, Pl. I, fig. 1.

Xysticus distinctus BANKS, 1892, Proc. Acad. Nat. Sci., Philadelphia, p. 52, Pl. III, fig. 89.

Xysticus transversus BANKS, 1892, idem, p. 54, Pl. III, fig. 6.

***Xysticus punctatus* Keyserling**

Xysticus punctatus Keyserling, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 30, Pl. I, fig. 13.

Xysticus formosus BANKS, 1892, Proc. Acad. Nat. Sci., Philadelphia, p. 56, Pl. III, fig. 9.

Xysticus emertoni Keyserling

Xysticus emertoni KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 39, Pl. I, fig. 18.

Xysticus limbatus KEYSERLING, 1880, idem, p. 35, Pl. I, fig. 16 (not female).

The female of *X. limbatus* Keyserling, as heretofore regarded by most American authors, belongs with *X. elegans* Keyserling. Emerton correctly matched the two sexes in his paper on New England Thomisidae. I synonymize the name *limbatus* with *elegans* because the female was described first and should be regarded as the type of the species. *Xysticus emertoni* is a very widely distributed species. It is rather uncommon in the United States but seems to be abundant in Canada.

Xysticus elegans Keyserling

Xysticus elegans KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 31, Pl. I, fig. 14 (not female).

Xysticus limbatus KEYSERLING, 1880, idem, p. 35, Pl. I, fig. 16 (not male)

Xysticus pulverulentus Emerton

Xysticus pulverulentus EMERTON, 1894, Trans. Connecticut Acad. Arts and Sci., IX, p. 417, Pl. IV, fig. 6.

This species was incorrectly synonymized with *X. montanensis* Keyserling. It is a common species in Canada and I have seen specimens from Minnesota, Utah, and Wyoming in the United States. It belongs in that section of the genus in which the bulb of the male palpus is devoid of apophyses.

Xysticus deichmanni Sorensen

Xysticus deichmanni SORENSSEN, 1898, Vidensk. Meddelelser, p. 228.

Xysticus bimaculatus EMERTON, 1894, Trans. Connecticut Acad. Arts and Sci., IX, p. 416, Pl. IV, fig. 5 (name preoccupied).

Xysticus benefactor Keyserling

Xysticus benefactor KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 22, Pl. I, fig. 8.

Xysticus vernilis KEYSERLING, 1881, Verh. k. k. zool.-bot. Gesell., Wien, p. 304, Pl. XI, fig. 23.

Xysticus orizaba Banks

Xysticus orizaba BANKS, 1898, Proc. California Acad. Sci., I, p. 260, Pl. XVI, fig. 6.

Xysticus paiutus GERTSCH, 1933, Amer. Mus. Novit., No. 593, pp. 17-19, figs. 16 and 20.

A comparison of *X. paiutus* with cotypes of Bank's *orizaba*, deposited in the collection of the Museum of Comparative Zoölogy,

shows that both are identical. The species was first described from Mexico. It is fairly common in the southwestern states and has been taken as far north as Idaho.

***Xysticus lassanus* Chamberlin**

Figure 7

Xysticus lassanus CHAMBERLIN, 1925, Bull. Mus. Comp. Zool., LXVII, p. 218.

Xysticus simplicior CHAMBERLIN AND GERTSCH, 1929, Pomona College Jour. Ent. and Zool., XXI, p. 5, Pl. I, fig. 10.

X. lassanus Chamberlin was based on a partly digested specimen taken from the stomach of a toad. A female that probably belongs with the male comes from near Carlsbad Cave, New Mexico. A figure of the epigynum is given. A prominent lobe projects into the atrium from the caudal margin as in *Xysticus variabilis* Keyserling.

***Xysticus variabilis* Keyserling**

Figure 5

Xysticus variabilis KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 40, Pl. I, fig. 19.

***Xysticus texanus* Banks**

Figure 8

Xysticus texanus BANKS, 1904, Jour. New York Ent. Soc., XII, p. 112.

***Xysticus laticeps* Bryant**

Figure 14

Xysticus laticeps BRYANT, 1933, Bull. Mus. Comp. Zool., LXXIV, pp. 178-179, Pl. III, fig. 25.

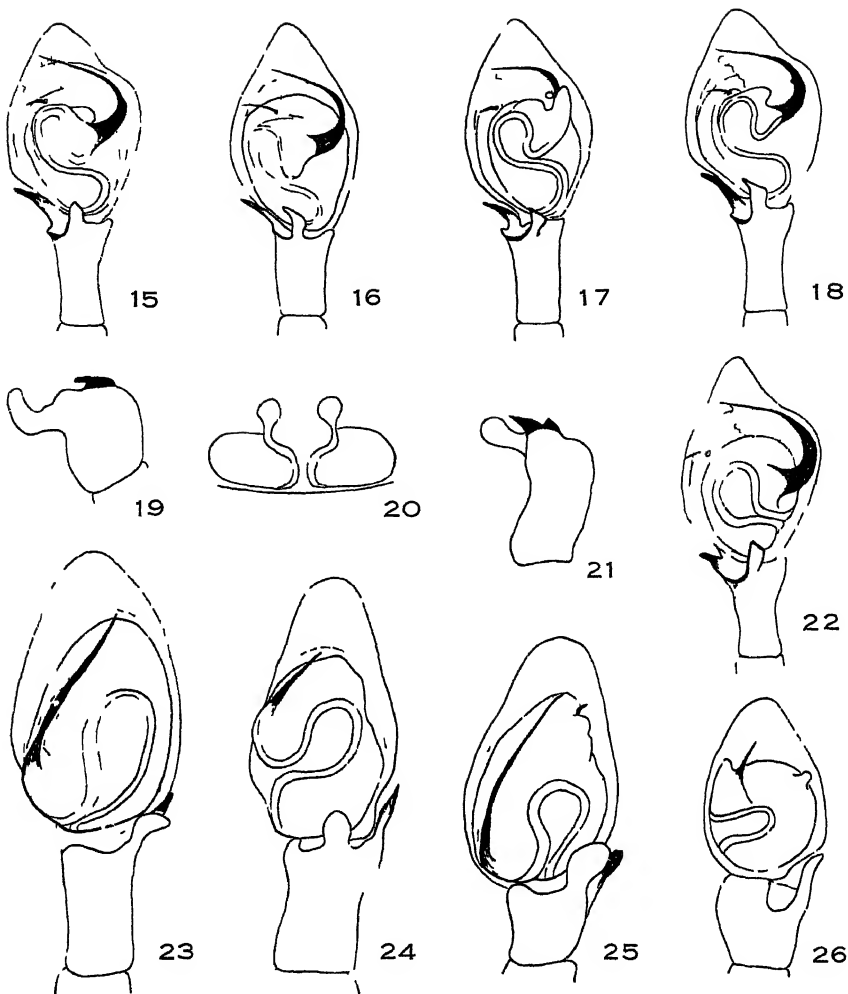
OXYPTILA Simon

***Oxyptila okefinokensis*, new species**

FEMALE.—Total length, 4.66 mm. Carapace dark brown, medially lightened to form a broad, longitudinal, reddish-brown stripe that is constricted at the position of the median cephalic suture, the margins with a lighter band. Clypeus yellow. Sternum black, light brown on the margins, the mouth parts and coxae yellow but maculate in black. Integument of the legs yellow, irregularly marked with large black maculations. Abdomen almost black, with a pale median basal stripe and a few lighter spots, the venter lighter. Abdomen provided with clavate spines.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2.20	.50	1.05	.50	.75	2.50 mm.
Width	2.30	1.27	.87	.35	.30	2.75 mm.

Eye rows recurved, the first narrower than the second in the ratio 40:47. Ratio of the eyes: ALE:AME:PLE:PME=7:3:5:4. Anterior median eyes scarcely twice as far apart as their distance to the laterals. Posterior median eyes much nearer each other than the laterals (10/15). Median ocular quadrangle broader than



PALPI AND EPIGYNA

- Fig. 15. *Philodromus californicus* Keyserling.
 Fig. 16. *Philodromus barrousi*, new species.
 Fig. 17. *Philodromus wyomingensis*, new species.
 Fig. 18. *Philodromus expositus* Keyserling.
 Fig. 19. *Philodromus mediocris*, new species (tibia).
 Fig. 20. *Philodromus anomalus*, new species.
 Fig. 21. *Philodromus speciosus*, new species (tibia).
 Fig. 22. *Philodromus keyserlingi* Marx.
 Fig. 23. *Philodromus speciosus*, new species.
 Fig. 24. *Philodromus josemitensis*, new species.
 Fig. 25. *Philodromus peninsulanus*, new species.
 Fig. 26. *Philodromus anomalus*, new species.

long (15/13), very slightly broader in front, the anterior medians slightly smaller and placed two and one-half diameters from the clypeal margin. Eye area with several clavate spines, two in the median quadrangle, one between the lateral eyes, one immediately behind and other smaller ones on the sides. Clypeal margin with nine toothed spines, the central one clavate and directed upward.

First femur as long as the carapace, the patella and tibia slightly longer (5/4). First tibia with 1-2-2-2 long spines beneath and with two intermediate pairs of smaller ones, the second tibia with 2-2-2. Metatarsi of the first two pairs of legs with four pairs of ventral spines. First metatarsus with a single lateral spine.

Epigynum as figured.

TYPE LOCALITY.—Female holotype from Billy's Island, Okefinokee Swamp, Georgia, June, 1912 (Crosby), in the collection of Cornell University.

This interesting species partakes of the characters of both *Oxyptila* and *Xysticus*. In typical *Oxyptila* the median eye quadrangle is much longer than broad and the spines are as follows: 2-2 beneath the first two tibiae, 2-2-2 beneath the metatarsi, and a single lateral on the first metatarsus. The median eye quadrangle of *O. okefinokeensis* is slightly broader than long and the number of spines beneath the tibiae and metatarsi is exceeded for typical *Oxyptila*. These characters are more or less constantly characteristic of *Xysticus*. However, the general aspect of the spider and the epigynum show that it should be placed in *Oxyptila*.

PARASYNAEMA F. Cambridge

The following two species are congeneric with *Parasyrnaema cirripes* (O. P. Cambridge), a common Mexican form that no doubt will be found in our extreme southwestern States. A third, undescribed species is known from Florida by a badly damaged male.

Parasyrnaema pictilis (Banks)

Misumena pictilis BANKS, 1896, Jour. New York Ent. Soc., IV, p. 91.

Parasyrnaema viridans (Banks)

Misumena viridans BANKS, 1893, Trans. Amer. Ent. Soc., XXIII, p. 71.

APOLLOPHANES F. Cambridge

Apollophanes texanus (Banks)

Apollophanes texanus BANKS, 1904, Jour. New York Ent. Soc., XII, p. 113, Pl. v, fig. 12, Pl. vi, fig. 20.

Philodromus syntheticus CHAMBERLIN, 1925, Proc. California Acad. Sci., xiv, 124, figs. 33 and 36.

Philodromus agamus CHAMBERLIN, 1928, Proc. Biol. Soc. Washington, VI, p. 182.

Philodromus crenifer CHAMBERLIN, 1928, idem, pp. 181-182 (not female type).

TITANEBO Gertsch

Titanebo californicus Gertsch

Titanebo californicus GERTSCH, 1933, Amer. Mus. Novit., No. 636, p. 14, fig. 12.

Ebo inquisitor BRYANT, 1933, Bull. Mus. Comp. Zool., LXXIV, p. 186, Pl. II, fig. 16, Pl. III, fig. 30 (not *P. inquisitor* Thorell).

PHILODROMUS Walckenaer

Philodromus infuscatus Keyserling

Philodromus infuscatus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 222, Pl. v, fig. 122.

Philodromus unicolor BANKS, 1892, Proc. Acad. Nat. Sci., Philadelphia, p. 61, Pl. III, fig. 22.

Philodromus macrotarsus EMERTON, 1917, Canadian Ent. XLIX, p. 271, fig. 22 (1 and 2).

Philodromus ulus CHAMBERLIN, 1921, Canadian Ent., LIII, pp. 245-246, fig. 6.

Philodromus anomalus, new species

Figures 20 and 26

MALE.—Total length, 2.75 mm. Carapace bright yellowish-brown, lightened just behind the eyes by a triangular creamy maculation. Sternum white, the mouth parts, coxae and legs bright yellow in color and without markings. Abdomen concolorous with the dorsum of the carapace, sparingly flecked in white, the venter nearly white.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.10	.30	.70	12	22	1 75 mm.
Width	1.10	.50	.62	.12	.13	1 12 mm.

Eyes of the first row narrower than the second in the ratio 17:24. Eye rows recurved, the anterior medians twice as far apart as their distance to the subequal laterals and only two-thirds of a diameter from the laterals. Eyes of the posterior row subequal, the medians scarcely twice as far apart as their distance to the laterals. Median ocular quadrangle broader than long (12/8), wider behind in the same ratio. Clypeus twice as high as the diameter of an anterior median eye.

Sternum slightly longer than broad, truncate behind, separating the posterior coxae by their width. Abdomen pointed behind, the sides subparallel for two-thirds the length. First two tibiae with two pairs of spines beneath, the normal distals lacking, the first two metatarsi, 2-2-2. Femur of the last leg equal in length to the carapace. Palpus as figured.

FEMALE.—Total length, 3.25 mm. Color and structure as in the male, the abdomen proportionately broader. Epigynum as figured.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.35	.30	.75	.17	30	2 20 mm.
Width	1.35	.55	.67	.17	19	1 75 mm.

TYPE LOCALITY.—Male holotype, female allotype, and immature female paratypes from Scottsdale, Arizona, January 29, 1903 (Britcher collection).

This species is closely related to *Philodromus infuscatus* Keyserling and *Philodromoides pratariæ* Scheffer in structural characters. The male of the last named form is unknown but its palpus will surely be of the unusual type as found in *infuscatus* and *anomalus*. The presence of five pairs of spines beneath the first two tibiae in *Philodromoides* is not deemed of great importance from a generic standpoint. Berland and Fage have recently synonymized it with *Philodromus*, a disposition with which no fault can be found.

***Philodromus barrowsi*, new species**

Figure 16

MALE.—Total length, 5.20 mm. Integument of the carapace gray, the sides light brown, the light median longitudinal stripe about as wide as the width of the last eye row, its margins uneven, and which encloses a median light-brown streak that runs the length of the carapace. Sternum, labium, and endites white, pointed with black spots. Legs gray to bluish gray, a little darker beneath, the femora with a narrow white stripe on the dorsal surface. Abdomen gray, with a brown basal hastate maculation that runs half the length of the dorsum, laterad of which are paired brown spots, caudally coalesced into a band.

Carapace, 2.23 mm. long, 2.16 mm. wide, .83 mm. in front.

Eye rows recurved, the first narrower than the second in the ratio 27:40. Eyes of the first row subequal, the medians separated by a diameter, half as far from the laterals. Posterior median eyes two and one-half diameters apart, about half as far from the slightly larger laterals. Median ocular quadrangle broader than long (20/16), two-thirds as broad in front as behind, the eyes subequal. Clypeus as high as the median ocular quadrangle.

Legs 2143, the anterior tibiae with 2-2-2, the metatarsi with 2-2 spines beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	3.73	1.23	3 33	3.23	1.73	13 25 mm.
II	4.50	1.46	4.33	4.00	2.13	16 42 mm.
III	3.53	1 10	2.93	2.86	1 33	11 75 mm.
IV	3.53	1.10	2.93	3.00	1.46	12 02 mm.

Male palpus closely related to the many species in the *pernix* group. Tibia with a ventral short lobed apophysis, its sclerotized margin connecting it with a heavier retrolateral apophysis that is weakly bifurcate. The eye relations and color characteristics are sufficient to separate it from *P. hoples* Chamberlin, *P. pernix* Blackwall and related species and races.

FEMALE.—Total length, 6.65 mm. Carapace, 2.56 mm. long, 2.50 mm. wide, 1.06 mm. in front. Agreeing well with the male in color, the chief difference being in the caudal markings of the abdomen, banded in the male, the spots distinct and separate in the female. Legs proportionately shorter, the second femur less than twice as long as the carapace (2.56/4.00). Epigynum much as in *pernix* and *hoples*.

TYPE LOCALITY.—Male holotype, female allotype and paratypes from Macon, Georgia, male and female paratypes from Gainesville,

Florida, February and March (Wm. M. Barrows). Also known from Texas and other southern states. The types are in the collection of The American Museum of Natural History.

***Philodromus wyomingensis*, new species**

Figure 17

MALE.—Total length, 4.66 mm. Carapace, 2.00 mm. long, 1.90 mm. wide, .66 mm. in front. Color and structure as in *P. californicus* Keyserling, *P. pennix* Blackwall and other species of the same group. Specific differences, however, are most apparent in the palpus, which is described in detail.

Tibia of palpus as long as the bulbal parts, provided laterally with a bifid apophysis, the superior process of which is much longer than in the inferior, the interval between rounded. The species is obviously close to *P. expositus* Keyserling in the details of the superior apophysis, but can be separated by differences in the details of the bulb. The median bulbal parts more elevated than in that species, the tube hidden partially by a sclerotized process much shorter and finer than in *expositus*. Cymbium more gently rounded on the prolateral margin, not expanded as in some species. Visible portion of the seminal canal originating near the inferior tibial process, strongly looped at the middle of the bulb, and from there entering the embolic portion.

TYPE LOCALITY.—Male holotype from Slough Creek, Yellowstone National Park, Wyoming, July 11, 1930 (W. E. Gertsch, collector), deposited in the collection of The American Museum of Natural History. A male paratype in the Britcher collection is probably from Scotsdale, Arizona.

***Philodromus keyserlingi* Marx**

Figure 22

Philodromus obscurus KEYSERLING, 1883, Verh. k. k. zool.-bot. Gesell., Wien, XXXIII, p. 675, Pl. XXI, fig. 23 (not *P. obscurus* Blackwall).

Philodromus keyserlingi MARX, 1889, Proc. U. S. Nat. Mus., XII, p. 559.

Philodromus washita BANKS, 1932, Pub. University Oklahoma, Biol. Survey, IV, No. 1, p. 28, figs. 1 and 2.

***Philodromus expositus* Keyserling**

Figure 18

Philodromus expositus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 220, Pl. v, fig. 121.

Philodromus signifer BANKS, 1892, Proc. Acad. Nat. Sci., Philadelphia, p. 59, Pl. III, fig. 20.

***Philodromus californicus* Keyserling**

Figure 15

Philodromus californicus KEYSERLING, 1883, Verh. k. k. zool.-bot. Gesell., Wien, XXXIII, p. 676, Pl. XXI, fig. 24.

Philodromus hoples CHAMBERLIN, 1928, Proc. Biol. Soc. Washington, XLI, p. 181.

***Philodromus virescens* Thorell**

Philodromus virescens THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 500.

Philodromus clarus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 214, Pl. v, fig. 117.

Philodromus crenifer CHAMBERLIN, 1928, Proc. Biol. Soc. Washington, XLI, pp. 181-182 (female type, not male).

***Philodromus alascensis* Keyserling**

Philodromus inquisitor THORELL, 1877, Bull. U. S. Geol. Survey, III, p. 502 (not *P. inquisitor* (Walckenaer)).

Philodromus lentiginosus KEYSERLING, 1881, Verh. k. k. zool.-bot. Gesell., Wien. XXXI, p. 312, Pl. xi, fig. 29.

Philodromus alascensis KEYSERLING, 1883, idem, XXXIII, p. 674, Pl. xxi, fig. 22.

Philodromus thorelli MARX, 1889, Proc. U. S. Nat. Mus., XII, p. 559 (not *P. thorelli* Cambridge).

Philodromus varians KULCZYNSKI, 1908, Mém. de l'Acad. Impériale des sci. de St.-Petersbourg, VIII Série, XVIII, No. 7, pp. 57-61, Pl. i, figs. 71-74, 77, 78, and 80.

Philodromus ubiquitor MELLO-LEITAO, 1929, Archivos do Mus. nac. Rio de Janeiro, p. 270.

Ebo oblongus BRYANT, 1933, Bull. Mus. Comp. Zool., LXXIV, pp. 188-189, Pl. III, fig. 23 (not *E. oblongus* Simon).

This interesting *Philodromus* was first described by Thorell in 1877 as *inquisitor*, a name preoccupied by Walckenaer in 1837. Probably the next eligible name is *lentiginosus* Keyserling, but as the type of that species, originally deposited in the collection of the Museum of Comparative Zoölogy, apparently has been lost, I have queried it and used *alascensis* Keyserling. Keyserling's original label for *lentiginosus*, which was described from the Lake Superior region, is still extant but the only specimen in the vial is an immature *Tibellus*. Two new names have been proposed to supplant *inquisitor*, but as the earlier synonymy was not clearly understood at that time, they become synonyms. In 1908 Kulczynski redescribed the species from Siberia as *Philodromus varians* and gave good figures of the palpus and epigynum. The superficial resemblance between *P. alascensis* and species of the genus *Titanebo* led to the identification by Bryant of a female from Auburn, Alabama, as *Ebo oblongus* Simon. The range of the species is extensive. It is found throughout most of Canada, the northern part of the Mississippi basin, all the region west of the Rocky Mountains, Alaska, and Siberia. It apparently has never been taken on the eastern seaboard and there is only one record from the southern states.

***Philodromus marxi* Keyserling**

Philodromus marxi KEYSERLING, 1889, Verh. k. k. zool.-bot. Gesell., Wien, XXXIII, p. 677, Pl. XXI, fig. 25.

Philodromus ornatus BANKS, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 61, Pl. III, fig. 24 (name preoccupied).

Philodromus minusculus BANKS, 1892, idem, p. 63, Pl. II, fig. 39.

Philodromus banksii MELLO-LEITAO, 1929, Archivos do Museo Nacional, Rio de Janeiro, p. 267.

***Philodromus imbecillus* Keyserling**

Philodromus imbecillus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 224, Pl. V, fig. 123.

Philodromus lineatus EMERTON, 1892, Trans. Connecticut Academy Arts and Sci., VIII, p. 374, Pl. XXXI, fig. 4.

Philodromus carolinus BANKS, 1911, Proc. Acad. Nat. Sci. Philadelphia, p. 452, Pl. XXXV, figs. 14 and 16.

Philodromus mediocris*, new species*Figure 19**

MALE.—Total length, 2.80 mm. Cephalothorax provided with a sparse covering of gray hairs that are best represented on the margins, and a few weak spines in the ocular region. Carapace light brown in the middle, the sides somewhat darker, the median band very poorly defined. Labium, endites, and sternum creamy white in color, the latter with a submarginal line of black dots. Legs light yellowish-brown, the basal joints with a prolateral and retrolateral brown stripe. Abdomen light reddish-brown, the sides somewhat darker, the venter creamy white.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1 33	.36	.73	.16	.30	1 60 mm.
Width	1 28	.50	.66	.20	.20	1.00 mm.

Eye rows recurved, the first narrower than the second in the ratio 22:30. Ratio of the eyes: ALE:AME:PLE:PME=2.5:2.5:3:2.5. Anterior median eyes separated by scarcely three diameters, about half as far from the laterals. Posterior median eye separated by six diameters, about two diameters from the larger laterals. Median ocular quadrangle much broader than long (19/10), greatly narrowed in front in the same ratio, the eyes subequal. Clypeus as high as the median quadrangle, a little more than three times the diameter of an anterior median eye.

Legs 2143, the first tibia with 2-2-2, the metatarsus with 2-2 spines beneath. The first femur slightly longer than the carapace, the second half again as long, the last two femora about equal to it in length.

Femur of male palpus longer than the patella and tibia together, about equal to the tarsus in length. Tibia with two apophyses, a colorless ventral lobe that expands distally and lies on the margin of the bulb, and a retrolateral sclerotized spur that is basally very broad and has a short prong directed ventrad.

TYPE LOCALITY.—Male holotype from Lake City, Florida, and male paratype from Gainesville, Florida, February 27, 1927 (Wm. H. Bar-

rows), the holotype in the collection of The American Museum of Natural History.

Philodromus satullus Keyserling

Philodromus satullus KEYSERLING, 1880, 'Die Spinnen Amerikas,' Laterigradae, p. 211, Pl. v, fig. 116.

Philodromus minutus BANKS, 1892, Proc. Acad. Nat. Sci. Philadelphia, p. 62, Pl. vi, fig. 85.

Philodromus brevis EMERTON, 1892, Trans. Connecticut Acad. Arts and Sci., VIII, p. 375, Pl. xxxii, fig. 2.

Philodromus deceptus, new species

MALE.—Total length, 2.65 mm. Carapace dark brown on the sides, medially with a very broad longitudinal light band that is as wide as the first row of eyes, the clypeus and most of the area of the eyes light brown. Sternum very light, the labium, endites, and coxae a little darker. Legs irregularly marked with large brown maculations. Abdomen dark brown, provided basally with a lighter hastate marking that is outlined in white. Venter dirty white.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.22	.20	.65	.20	.25	1.48 mm.
Width	1.17	.55	.57	.17	.17	.95 mm.

The first row of eyes recurved, narrower than the second in the ratio 21:30, the eyes subequal, the medians separated by two and one-half diameters, nearer the laterals (4/6). Second row of eyes less recurved, the medians widely separated and much nearer the larger laterals (5/12), than each other. Median ocular quadrangle much broader than long (16/10), narrower in front in the same ratio, the eyes subequal. Clypeus equal to seven-tenths the height of the median quadrangle.

Legs 2143, the first tibia with 2-2-2 spines beneath, the metatarsus with two pairs. The first femur is about as long as the carapace (1.25 mm./1.22 mm.), the last tibia and patella shorter (1.05 mm./1.22 mm.).

Male palpus very close to that of *Philodromus satullus* Keyserling (synonym *minutus* Banks), the difference in the lateral tibial apophysis being mainly one of size. This process is less than half as long in *deceptus* and placed much nearer the cymbium. The embolus is a strong black spur half as long as the bulbal apparatus and lies in a moderately excavated fold near the distal end. The course of the seminal canal is very much as in *satullus*. The cymbium is as long as the tibia and patella taken together.

TYPE LOCALITY.—Male holotype from Gainesville, Florida, February 27, 1927 (W. M. Barrows, collector) deposited in the collection of The American Museum of Natural History through the courtesy of Dr. Barrows.

This species falls in the same group with *Philodromus satullus* Keyserling, *inaequipes* Banks and others in which the median eyes of the second row are widely separated. Efforts to connect this species with

several different females from Florida were not satisfactory and for the present the species is known only from the male sex.

***Philodromus peninsulanus*, new species**

Figure 25

MALE.—Total length, 3.00 mm. Carapace yellowish brown throughout, the sparse covering of hair black, inconspicuous. Sternum somewhat lighter, completely lacking hairs or spines. Legs and palpi concolorous with the carapace, inconspicuously punctate in black, provided with weak spines and black hairs. Dorsum of abdomen lighter than the carapace, lacking any signs of a darker pattern, the venter light.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.37	.28	.90	.19	.33	1.80 mm.
Width	1.30	.60	.70	.20	.25	.85 mm.

Eye rows recurved, the first narrower than the second in the ratio 20:30. Ratio of the eyes: ALE:AME:PLE:PME=2.5:2.5:3:2.5. Anterior median eyes separated by two diameters, about half as far from the equal laterals. Posterior median eyes separated by about five diameters, half as far from the larger laterals. Median ocular quadrangle much broader than long (17/9), greatly narrowed in front in the same ratio, subequal. Clypeus two-thirds as high as the median quadrangle.

Legs 2143, the first tibia with 2-2-2 spines beneath, the metatarsus with two pairs. The first femur clearly longer than the carapace (1.65/1.37), the last two femora slightly longer (1.50/1.37).

Tibia of male palpus with the conventional apophyses, a flat, colorless ventral lobe that is rounded distally and a dark spur on the retrolateral margin that ends in a fine point. Embolus a slender spine originating near the base of the cymbium on the inner side and lying close to the bulb for its full length, parallel to the course of the seminal duct.

TYPE LOCALITY.—Male holotype from Cocoa, Florida, December 23, 1925, deposited in the collection of The American Museum of Natural History through the generosity of Dr. W. M. Barrows who collected the species.

Although closely related to *Philodromus ornatus* and *placidus*, this small species can immediately be separated from them by the comparative ratios of the ocular quadrangle. In both the former species the quadrangle is somewhat broader than long (14/9) but in *peninsulanus* it is decidedly broader, in the ratio 17:9. The tibial apophysis is equivalent in length and shape to that of *P. placidus*.

***Philodromus speciosus*, new species**

Figures 21 and 23

MALE.—Total length, 2.80 mm. Carapace dark brown on the sides, medially with a very light whitish band as wide as the eye rows and ending at the caudal margin, the sides parallel. Clypeus dark brown. Sternum creamy white, the abium, endites and coxae dirty gray. Legs yellow, most of the joints with proximal

and distal annulae, the femora infuscated. Abdomen with a basal hastate brown marking above, around which is a large white field; black beyond the middle, caudally again whitened, the venter white with two side stripes.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.26	.26	.80	.16	.30	1.60 mm.
Width	1.26	.60	.77	.16	.16	1.00 mm.

Eye rows recurved, the first narrower than the second in the ratio 17:25. Ratio of the eyes: ALE: AME: PLE: PME=3: 3: 3.5: 3. Anterior median eyes separated by scarcely a diameter, less than half as far from the laterals. Posterior median eyes separated by about two diameters, nearly as far from the slightly larger laterals. Median ocular quadrangle slightly broader than long (12/10), much narrower in front, the eyes subequal. Clypeus as high as twice the diameter of an anterior median eye.

Legs 2143, the anterior tibiae and metatarsi with 2-2 spines beneath, the normal distals completely lacking or very small.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.16	.66	2.06	1.86	1.13	7.87 mm.
II	2.50	.66	2.43	2.33	1.30	9.22 mm.
III	1.66	.53	1.53	1.46	.80	5.98 mm.
IV	1.80	.53	1.53	1.46	.80	6.12 mm.

Ratio of coxae I: II: III: IV=1.4: 1.4: 1.4: 1.7.

Femur of male palpus a little longer than the patella and tibia taken together. Tibia with two processes as in *Philodromus exilis* Banks, the ventral a colorless rounded lobe that projects slightly over the bulbal margin, the retrolateral apophysis considerably broader than in *exilis* and shallowly notched, the forks asymmetrical. Bulb little expanded, the tube originating near the middle on the prolateral side of the bulb and ending at the distal bulbal margin.

FEMALE.—Total length, 4.00 mm. Pattern and color of this sex agreeing exactly with the male. Legs proportionately a little shorter. Other structural characteristics of the carapace and the relations of the eyes very similar. Abdomen, as usual, much larger. Epigynum identical with that organ in *Philodromus imbecillus* Keyserling.

TYPE LOCALITY.—Male holotype and female allotype from Montpelier, Idaho, July 1930 (Gertsch); male paratypes from Yellowstone National Park, Wyoming, August 1931 (Walter E. Gertsch); male and female paratypes from Los Angeles, California (G. Grant); female and immature male paratypes from Salt Lake City, Utah, July-August 1931 (Gertsch). Types in the collection of The American Museum of Natural History.

Philodromus josemitensis, new species

Figure 24

MALE.—Total length, 3.00 mm. Carapace black, with a narrow median longitudinal band that is divided anteriorly into three streaks, the median one going forward between the anterior median eyes, the lateral ones ending at the posterior lateral eyes. Clypeus margined in white. Legs all black, indistinctly annulate distally.

Abdomen nearly black, showing no lighter color above or below. A male paratype is probably more representative of the normal color form of the species, and has a conspicuous broad median white band on the carapace, the sides being light reddish-brown. The abdomen is considerably lighter, also, its basal color being light brown. The integument of the legs is light yellow and the joints are conspicuously annulate in black.

Carapace, 1.26 mm. long, 1.33 mm. wide, .50 mm. in front.

Eye rows recurved, the first narrower than the second in the ratio 16:25. Eyes of the first row subequal, the medians separated by a little more than a diameter, half as far from the laterals. Posterior median eyes separated by scarcely three diameters, five-eighths as far from the equal laterals. Median ocular quadrangle slightly broader than long, considerably broader behind, the eyes subequal. Clypeus as high as the height of the median quadrangle.

Legs 2143, the second femur about twice as long as the carapace, the spines rather feeble, the first and second tibiae with 2-2-2, the metatarsi with 2-2 beneath.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.86	.56	1.80	1.66	.93	6.81 mm.
II	2.33	.76	2.16	2.06	1.06	8.37 mm.
III	1.80	.56	1.46	1.33	.66	5.81 mm.
IV	1.70	.46	1.33	1.33	.66	5.48 mm.

Femur of palpus slightly longer than the patella and tibia taken together, which are about equal in length to the tarsus. Tibia with two apophyses, a subventral colorless rounded lobe that projects over the cymbium near the outer side and a retrolateral slender spur that is as long as the other but acutely ended. Embolus a strong spine that originates halfway up the prolateral margin of the bulb and ends at the bulbal apex.

TYPE LOCALITY.—Male holotype from Yosemite National Park, California (Sternitzky), and male paratype from Stanford University environs, California (J. C. Chamberlin, collector), the paratype deposited in the collection of the University of Utah, the holotype in the collection of The American Museum of Natural History.

Philodromus lutulentus, new species

MALE.—Total length, 3.62 mm. Carapace light brown throughout, clothed with a few iridescent scales and inconspicuous short black hairs, spines present only on the clypeal margin and at the sides of the pars thoracica. Sternum dirty white, the coxae, labium and endites yellow, concolorous with the integument of the appendages, which are sparsely marked with small brown spots and dark streaks above. Dorsum of abdomen light brown, darker medially, the sides of the posterior half lighter, the venter dirty white.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.70	.50	.95	.20	.40	2.00 mm.
Width	1.70	.60	.85	.23	.30	1.40 mm.

Eye rows recurved, the first narrower than the second in the ratio 27:36. Eyes of the first row subequal, the medians separated from each other by two diameters,

about half as far from the laterals. Second row of eyes less recurved, the medians four diameters apart, half as far from the slightly larger laterals. Median ocular quadrangle much broader than long (20/12), narrower in front in the same ratio, the eyes subequal. Clypeus as high as the median ocular quadrangle.

Legs 2143, the first femur slightly longer than the carapace, the second femur considerably longer, the first tibiae with 2-2-2 spines beneath. the metatarsi with two pairs.

Femur of the male palpus slightly longer than the patella and tibia, which two joints are longer than the tarsus. Tibia with two apophyses as in *Philodromus robustus* Emerton, a lateral spur and a much shorter ventral process. Bulbal parts nearly round, the embolus a stout spine free from the bulb at the base on the pro-lateral side and curved around the periphery to the distal end. Course of the seminal duct much as in *robustus*.

TYPE LOCALITY.—Male holotype from Atlanta, Georgia, May, 1899, collected by J. H. Emerton and given to The American Museum of Natural History by Dr. W. M. Barrows of Ohio State University.

I have compared this interesting species with the type of *Philodromus robustus* Emerton and find that the two are distinct. In this connection it may be hazarded that *robustus* is the male of *P. laticeps* Keyserling, but more material is necessary to decide this point. Both of the species have been taken in New England, each known by only one sex.

Philodromus mineri Gertsch

Philodromus mineri GERTSCH, 1933 (June 15), Amer. Mus. Novit., No. 636, pp. 14-15, Fig. 21.

Philodromus emertoni BRYANT, 1933 (June), Bull. Mus. of Comp. Zool., LXXIV, pp. 184-185, Pl. II, figs. 17, 22, Pl. III, fig. 34.

Tibellomimus lineatus Gertsch

Tibellomimus lineatus GERTSCH, 1933 (June 15), Amer. Mus. Novit., No. 636, p. 9.

Philodromus bilineatus BRYANT, 1933 (June), Bull. Mus. of Comp. Zool., LXXIV, pp. 181-182, Pl. II, figs. 14-19, Pl. III, fig. 29.

The male of this species, unknown at the time of the description of *Tibellomimus*, agrees well with the female structurally and differs from typical *Philodromus* in the marginal position of the eyes on the greatly flattened carapace, which is much longer than wide. The palpus resembles species of *Philodromus* very closely, and if it should prove necessary ultimately to refer the species to this genus, the specific name *bilineatus* must be used, for *lineatus* is preoccupied by Emerton.

59,9, 32 (6)

FOURTEEN HITHERTO UNRECOGNIZED AFRICAN
RODENTS¹

BY ROBERT T. HATT

A study of the rodents of the American Museum Congo Expedition entailed identification of much additional material in the collections of this museum, and required, moreover, the examination of material in certain European museums. During the course of these investigations it was found that a number of specimens in American Museum collections and in the British Museum could not be assigned to known forms. In this paper some of these specimens are described.

I wish to acknowledge my great appreciation of the friendly courtesy of Mr. M. A. C. Hinton of the British Museum, who allowed me to study the collections in his charge and granted me the privilege of describing as new certain of the specimens named below. My thanks are also extended to Mr. H. E. Anthony of the American Museum, for his permission to describe a handsome gerbille that he collected on the White Nile, and to record his field notes on the species. The drawings are by Dr. Florence Dowden Wood.

In these descriptions where the color terms are those of Ridgeway, they are capitalized.

Otomys tropicalis faradjius, new subspecies

TYPE.—American Museum of Natural History No. 50357. American Museum Congo Expedition No. 1561. Male adult. Collected at Faradje, upper Uele district, Belgian Congo, March 26, 1911, by James P. Chapin. The type is a skin with skull, both in good condition.

PARATYPES.—Six males and three females collected at the type locality between February 21 and April 15, 1911 (A.M.N.H. Nos. 50353–50356 and 50358–50362).

GENERAL CHARACTER.—Dorsal color very dark reddish-brown, size small. The large ears are almost hairless. Skull proportions broader than in *elgonis*; the interparietal shorter and the basisphenoid more delicate than in that subspecies.

DESCRIPTION.—General color above not near any of Ridgeway's standards, but perhaps nearest Chestnut. The light bands of the dorsal hairs are Buckthorn Brown. Proximal to this band is one of intensely dark Chestnut. The numerous guard hairs are an iridescent dark brown. The under side is gray, washed with Light Buff, which is the color of the tips of the longer hairs. Hands and feet are clothed with glossy

¹Scientific results of the Congo Expedition. Mammalogy, No. 13.

dark Chestnut hairs. The tail is black above, light below. The light nasal patch is Ochraceous-Buff.

The skull is typical of the *tropicalis* group, differing from its neighbor *elgonis* in its smaller size and the diagnostic characters given above.

MEASUREMENTS.—Collector's measurements of the type: total length, 277 mm.; tail, 97; hind foot with claw, 32; height of ear from notch, 22. Skull measurements: greatest length, 39.7; condylobasal length, 38.6; length of nasal suture, 16.9; greatest breadth across both nasals, 7.6; zygomatic breadth, 19.8; interorbital breadth, 4.7; breadth of brain case, 15.6; skull height, 12.6; height from sinciput to alveolar border M^3 , 12.8; palatal length, 21.6; length of anterior palatal foramina, 7.2; width of palate inside M^1 , 1.9; crown length of upper tooth row, 8.4; condylo-incisive length of mandible, 26.3.

Taterillus emini anthonyi, new subspecies

TYPE.—American Museum of Natural History No. 82211. Taylor Sudan Expedition No. 3006. Female adult. Collected on the west bank of the White Nile, 20 miles south of Jelelein, Anglo-Egyptian Sudan, February 2, 1927, by H. E. Anthony. The type is a well-made skin, complete and in unworn pelage, accompanied by a skull complete except for the malar bones which have been lost.

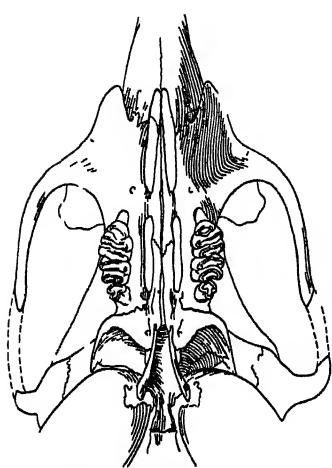
PARATYPE.—A.M.N.H. No. 82208. Female adult. Collected at Akona, west bank of the White Nile, February 7, 1927, by H. E. Anthony. A slightly younger specimen than the type. The malar bones of this skull also are missing.

GENERAL CHARACTERS.—A northern pallid representative of the *emini-butleri* group, externally characterized by extremely pale coloration, large body size, and long tail. Its skull is larger than those of its nearest relatives, *butleri* and *emini*, and differs from these also in having broader, flatter-topped nasals, strong supraorbital and temporal ridges. The pterygoid region is characteristic, the pterygoid fossa being short and broad, the pterygoid processes strong, very nearly straight and widely divergent.

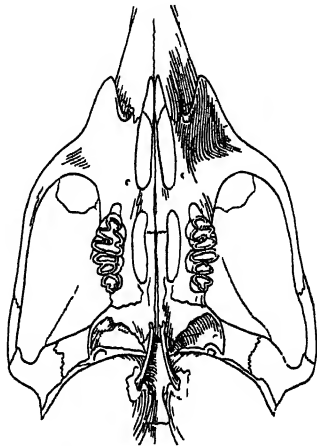
DESCRIPTION.—General color above, from nose to the base of the tail, Tawny-Olive, paling high on the flanks to Cinnamon-Buff. The comparatively light shade of the upper surface is due to the extremely light color of the middle band of the hair shaft which in this race is near Chamois, and in its most closely related subspecies, *butleri*, is Honey Yellow. The belly, chin, throat, lower half of cheeks, supraorbital spot, and the feet are pure white. The dark eye ring is less pronounced than in *emini*. The short hairs on the upper side of the basal two-thirds of the tail are near Bister. The longer hairs on the upper part of the terminal third of the tail are Bone Brown. Those of the under side of the tail are wide. The mammae are 2-0-2=8.

The skull of this race is larger than that of its relatives but in general proportions is in no way peculiar. It differs, however, in having relatively broad flat-topped nasals (in the older specimen), and well developed supraorbital and temporal ridges. These ridges are prominent not only in the type but also in the younger paratype. The most striking difference between this and the other races lies in the pterygoid region, which is characterized by a shallow broad fossa, flanked by short stout divergent pterygoid processes. This is in marked contrast to *butleri* and *emini*, in which the fossa is long, narrow, and bounded laterally by thin pterygoid processes. The less striking difference between the White Nile race and *T. e. congicus* is indicated in the accompanying figure.

MEASUREMENTS.—Collector's measurements of the type and paratype (the latter given in parentheses): total length, 316 (298) mm.; tail, 182 (170); hind foot with claw, 35 (35). Skull measurements: greatest length, 37.4; condylobasal length, 33.3; length of nasal suture, 14.5; zygomatic breadth at posterior tip of maxillae, 18.0; interorbital breadth, 7.3; breadth of brain case, 15.7; skull height, 14.4; palatal length, 19.7; length of posterior palatal foramina, 4.8; width of palate inside M^1 , 3.8; length of pterygoid fossa, 4.2; length of bullae, 10.2; alveolar length of upper tooth row, 6.0; width M^1 , 2.0; condylo-incisive length of mandible, 23.0.



Taterillus e. anthonyi ♀
AMNH No 82211 x 2



Taterillus e. congicus ♂
AMNH No 50287 x 2

Fig. 1

The large tufted-tailed gerbilles of the Jebelein district are strikingly different from the types and topotypes of other described species, but specimens in the British Museum from intermediate localities suggest complete intergradation. The subspecies here described resembles *butleri* more closely than any other known form, but there also appears to be intergradation between *butleri* and *emini* so that I am inclined to consider the new form a race of the earliest described member of the group, *emini*. I would also place *butleri*, *clivosis*, and *lacustris* as subspecies of *emini*. Specimens from 50 miles west of El Obeid, Kordofan, are in many respects intermediate between *T. e. butleri* and *T. e. anthonyi*.

Field notes in reference to the type are as follows: "February 2. . . . It was taken in a steel trap set in a burrow which I had opened out and proceeded as for a gopher set, covering the pit with debris to shut out

the light. There was a mound of fresh earth hiding the outlet of the burrow and the appearance of the 'working' was very gopher-like. I do not see how an animal with such weak fore legs could loosen such a pile of the lumpy sun-baked Nile mud. The other gerbille [*Tatera robusta*] was caught at a good-sized open burrow."

This gerbille, whose beautifully prepared skins it has been my pleasure to study, is named for its collector.

Lophuromys luteogaster, new species

TYPE.—American Museum of Natural History No. 49647. American Museum Congo Expedition No. 2360. Female adult. Collected at Medje, Ituri district, Belgian Congo, April 10, 1914, by Herbert Lang. The type is a skin with skull, both in good condition.

PARATYPE.—A.M.N.H. No. 49648. Female juvenile. Collected the same day and at the same place as the type. Skin with skull, the latter with the brain case crushed. This specimen, the only other known, agrees closely with the type in all characters except size, and the color of the under surface of the skin which here contains a stronger element of red, and is near Pinkish Cinnamon.

GENERAL CHARACTER.—This Ituri relative of *Lophuromys woosnami* is characterized by pale coloration, great extension of the light belly color, which color extends from root to tip of the belly hairs, unicolored tail, small ears and feet. Crani-ally it is marked by a broad zygomatic plate (about double the width of that of *woosnami*), short broad outline of skull (particularly marked in the nasal region), and presence of postorbital processes (completely lacking in *woosnami*).

DESCRIPTION.—Color above, uniformly Olive-Brown, unmarred by any lighter ticking. On the sides this pales rather sharply to the clear Warm Buff of the belly, a shade which extends from chin to tail base and on to the hands and feet. Within this area the hairs are uniformly colored from base to tip. The same Warm Buff colors the bases of the dorsal hairs but is completely masked by the dark terminal color. The tail is uniformly colored Vandyke Brown, above and below. Its hairs are small and inconspicuous. The scales, smaller than in related species, are arranged in rings about twenty-two to the centimeter in the middle of the tail. (In *woosnami* these are fifteen to the centimeter.)

The skull is short and broad, particularly in the nasal region. Well-marked postorbital processes are present, unlike the condition seen in other long-tailed *Lophuromys*. The zygomatic plate is about double the width of that of *L. woosnami* from Mount Ruwenzori. The molars are narrower than those of typical *L. woosnami*, but not more so than in *L. w. prittiei* of the Kivu.

MEASUREMENTS.—The measurements given are those of the type, except such as are in parentheses, which are of the juvenile paratype. Collector's measurements taken in the flesh: total length, 212 (143) mm.; length of tail, 102 (74); length of hind foot with claw, 22 (20); height of ear from notch, 18 (15). Cranial measurements: greatest length, 29.2; condylobasal length, 27.8; basilar length, 24.5; zygomatic breadth, 24.5; interorbital breadth, 6.0; width across postorbital processes, 7.5; length of zygomatic plate, 3.4; height from bullae to crown, 10.2; length of nasals, 12.1; diastema, 7.5; breadth of palate inside M^1 , 3.6; length of upper tooth row, 4.8; width M^1 , 1.8; condylo-incisive length of mandible, 18.2.

Lophuromys luteogaster, though resembling *L. woosnami* of Mt. Ruwenzori more than any other known species, approaches *L. nudicaudus* of the Cameroons in some characters. Thus, in body size, tail length, foot length, and cranial length, the Ituri animal is intermediate between the other two species. It resembles the Cameroons species in having a unicolored tail, in possessing postorbital processes, and lacking supraorbital ridges; in having the interorbital roof gently rounded, and in having a short muzzle with short palatal foramina. However, in such characters as its foot and belly color, the size of its tail scales, and its broad zygomatic plate, it is unique, and for the present I feel it advisable to consider it a full species.

***Cricetomys gambianus langi*, new subspecies**

TYPE.—American Museum of Natural History No. 51153. American Museum Congo Expedition No. 1198. Male adult. Collected at Faradje, upper Uele district, Belgian Congo, January 12, 1913, by Herbert Lang. The type is a study-skin with skull, complete and in good condition. The molars are moderately worn.

GENERAL CHARACTER.—This subspecies combines a very light-hued pelage with large skull and molars, narrow nasals and interparietals.

DESCRIPTION.—General color above a grayish Rood's Brown, formed by the admixture of dark glossy Vandyke Brown guard hairs, and the Vinaceous-Buff tips to the smaller hairs. The lower flanks are Vinaceous-Buff. There is no sharp color demarcation between the flanks and the belly which, in the thoracic and abdominal regions, is superficially Vinaceous-Buff, overlying the clearly visible gray of the basal part of the hairs. (In some other specimens this area is largely white.) The inguinal region is white. The lips are Pinkish Buff. This area is continuous with and shades gradually into the whiter areas of the lower cheeks, chin, throat, axillae, ulnar surface of the forearms, margins of the fore feet, and the toes. There is also a Pinkish Buff preauricular spot. The eye ring is Bone Brown, about four millimeters wide above the eye, about six below. The numerous hairs of the outer surface of the ear conch are Bone Brown, while the scattered few inside are much lighter brown. The metatarsal area is Warm Sepia, flanked by white on the foot margins and the toes. The basal 55 per cent of the tail is black, the distal portion white.

The skull, as in related subspecies, is rather short, with a broad brain case, broad interorbital region, strong supraorbital ridges, and the characters noted above. The nasals taper evenly from the tip to the rear.

MEASUREMENTS.—Those following measurements of the type are of a female paratype No. 51151. Collector's measurements: total length, 660 (660) mm.; tail length, 340 (345); length of hind foot with claw, 62 (65); height of ear from notch, 37 (39). Cranial measurements: greatest length, 67.0 (67.5); condylo-incisive length, 63.0 (63.9); zygomatic breadth, 31.9 (32.1); interorbital breadth, 10.7 (10.0); breadth of brain case, 22.7 (22.5); length of nasals, 27.6 (26.6); breadth across nasals, 8.8 (8.8); length of interparietal, 5.3 (5.0); breadth of interparietal, 7.9 (7.9); height of brain case, basal suture to crown, 18.6 (17.7); width of upper arm of anterior zygomatic root, 2.2 (2.1); width of lower arm of anterior zygomatic root (zygomatic

plate), 5.6 (6.2); palatal length, 36.2 (36.5); diastema, 21.0 (21.0); anterior palatal foramina, 6.0 (6.8); breadth of palate across M^1 , 13.3 (13.2); length of upper molar tooth row, 10.5 (10.7); breadth M^1 , 3.3 (3.3); breadth of pterygoid fossa 5.1 (5.4); condylo-incisive length of mandible, 47.6 (47.6).

Cricetomys gambianus langi differs from the Sudanese race, *grahami* in having a generally lighter color, and far larger skull and molars. It is distinguished from *dichrura* of Southern Nigeria, in much paler, grayer coloration; lesser extension of black onto the tail; longer, denser hair, particularly on the belly, narrower nasals and interparietal. *C. g. langi* is very nearly the same general shade as *C. g. olivae* of Northern Nigeria but is unlike that subspecies in having a shorter tail, hairier belly, white borders to the feet, narrower skull, narrower interparietal, no post-orbital process, narrow limbs of the anterior zygomatic roots, and narrower pterygoid fossa. The newly recognized race of the savannas of the northeastern Congo seems most closely related to *dichrura*.

This new subspecies is represented in American Museum collections by fifteen specimens, including the type. All were secured at Faradje and Niangara by the Congo Expedition. I am pleased to name the race for Mr. Lang, collector of the series.

***Dasmys nudipes edsoni*, new subspecies**

TYPE.—American Museum of Natural History No. 86889. Chapin-Edson Collection No. 2179. Male adult. Collected at Lukolela, middle Congo, November 8, 1930, by James P. Chapin. The type is a well-made study-skin in unworn pelage, with skull. The skull is perfect except for the posterior margin of the palate and the posterior median wall of the left bulla, which are missing. Its molars are well worn.

GENERAL CHARACTER.—Differing from the Angolan *Dasmys nudipes* in generally smaller size, shorter foot, shorter hair and smaller skull, relatively narrow brain case, and small molars.

DESCRIPTION.—General color above, Chocolate. In certain lights the tips of the guard hairs reflect a greenish iridescent tone. The sides pale to a mixture of Cinnamon-Buff and gray, the latter owing to the exposure of the basal part of the hair. The tips of the hairs of the under side are white but their dark gray bases are much exposed. The fore and hind feet are colored as the flanks. The short inconspicuous tail hairs are dark brown except on the under side of the basal half, where they are white.

The skull differs little from typical *nudipes* except in characters noted above. The proportions in general are lighter. The sutures of the roof of the brain case in the type are highly convoluted, whereas those of all Angolan specimens of *nudipes* at hand have relatively straight simple sutures. As in *nudipes* the supraorbital ridges are very strongly developed. The anterior palatal foramina extend to the level of the anterior margin of the first molars. The pterygoid processes are heavy and their lower margins flare laterally more than in *nudipes*.

MEASUREMENTS.—Collector's measurements, taken in the flesh: total length, 323 mm.; tail length, 164; length of hind foot with claw, 37; height of ear, 15. Skull measurements: greatest length, 36.9; condylobasal length, 36.7; length of nasal suture, 15.3; zygomatic breadth, 18.8; interorbital breadth, 4.6; breadth of brain case, 13.5; length of interparietal, 4.0; breadth of interparietal, 7.8; greatest skull height, 11.9; length of anterior palatal foramina, 8.5; width of palate inside M^1 , 3.4; length of bullae, 6.0; alveolar length of upper tooth row, 6.7; width M^1 , 2.4; condylo-incisive length of mandible, 26.3.

The type was obtained from a workman who said that he had caught it at the border between grassland and forest.

Specimens from Luluabourg are intermediate between *nudipes* and *edsoni* but nearer the former.

This mouse is named for Mr. Franklin Edson, III. He and Doctor Chapin made for this museum an excellent collection of mammals of the south bank of the middle Congo.

Aethomys walambae hintoni, new subspecies

TYPE.—British Museum No. 7.12.13.46. Male adult. Collected at Kambove, Katanga (altitude 4400 feet) March 1, 1907, by S. A. Neave. The type is a well-made skin in unworn pelage, accompanied by a skull complete except for a narrow piece of the brain case extending from the center of the left parietal to the lowest point of the left temporal. The molars are well worn.

GENERAL CHARACTER.—Darker and redder than *walambae*. The adults have a unicolored tail, which is shorter than in true *walambae*. The skull is also narrower than in the typical race.

DESCRIPTION.—General color near Russet above, paling on the sides and grading without sharp demarcation into very pale gray on the under surface. The cheeks are grayish. There is no dark orbital ring. The hands and feet are white, as is typical in the genus. The ears, which are almost naked, are lighter in color than the general dorsal coloration. The scales of the entire tail are uniformly Bone Brown. The numerous short hairs of the tail are dark brown, except for those of the basal half of the under side, which are white.

The skull resembles that of typical *walambae*, but is somewhat more slender, has a narrower palate, and a broader zygomatic plate.

MEASUREMENTS.—Measurements of the type of *walambae* (those of the skull are mine) are given in parentheses, following the measurements of *hintoni*. Collector's measurements are: length of head and body, 156 (155) mm.; tail length, 119 (128); length of hind foot without claw, 26 (25, which is wrong, since in the dried specimen the foot measures 26.5 without claw). The ear measurement is recorded as 12.5, obviously an error. Cranial measurements: greatest length, 38.1 (37.8); condylo-incisive length, 37.4 (36.8); palatal length, 20.0 (18.9); greatest breadth, 19.5 (21.0); interorbital breadth, 5.7 (6.2); breadth of brain case, 15.0 (14.9); breadth of zygomatic plate, 6.2 (5.6); length of nasals, 15.0 (14.9); occipital height of brain case, 10.5 (10.5); length of bullae, 7.8 (7.9); breadth of palate across M^1 , 8.0 (8.6); alveolar length of upper molar row, 7.9 (7.6); width M^1 , 2.5 (2.4); greatest length of mandible, 27.1 (27.0).

This race is distinguished from *A. w. pedester* of southwestern Uganda by its shorter foot, unpigmented skin of hands and feet, and lesser pigment in the tail scales, shorter tail, smaller skull, smaller bullae, narrower palatal foramina, the vertical edge of the zygomatic plate, and longer tooth row. From *A. w. amalae* of the Southern Guaso Nyiro, it is differentiated in redder pelage, dark under side of the tail, longer tooth row, larger bullae, and narrower palatal foramina.

I have examined two topotypes in the British Museum. Also referred to *A. w. hintoni* are specimens in the Musée du Congo Belge. Two are from Elizabethville (Nos. 10086–10087) and one from wooded savanna at Lubumbashi, near Elizabethville (No. 10677). Specimens seen from various localities in Northern Rhodesia are referable to *A. w. walambae*.

It is my pleasure to distinguish this animal by naming it for Mr. M. A. C. Hinton.

Aethomys chrysophilus dollmani, new subspecies

TYPE.—British Museum No. 7.12.13.52. Male adult. Collected along the upper Lufira River, Katanga, Belgian Congo, June 15, 1907, by S. A. Neave. The type is a well-made skin with skull. The skin is in good condition except that the tail has been pushed up into the body for a considerable portion of its length. The skull, with greatly worn molars, is complete except for the left malar bone and a fragment of the brain case extending from the coronal suture to the root of the left zygoma.

GENERAL CHARACTER.—A northern representative of *A. chrysophilus* with darker hair, grayer belly, and comparatively short tail.

DESCRIPTION.—General color above Ochraceous-Tawny, interrupted with the exposed Slate Color of the basal three-fourths of the hair shafts. On the flanks this pales gradually. At the lower margin of the flanks there is an abrupt change to a soiled white tone through which the gray basal third of the hair shafts show prominently. The lips and chin are the color of the belly. A large ill-defined spot below the eye is Cinnamon-Buff. The eye ring in the type is inconspicuous, though this is not true in other specimens. The tail is uniformly Warm Sepia, above and below, though inconspicuous white hairs clothe the basal half of the ventral surface. The hands and feet are clear white. The ears are Chocolate.

The skull is similar to that of *A. c. chrysophilus*.

MEASUREMENTS.—Collector's measurements are: head and body, 145.5 mm.; tail, 158.5; hind foot without claw, 28.5; ear, 19. Cranial measurements (those taken from the type of *A. chrysophilus* follow in parentheses): greatest length, 37.5 (37.0); condylobasal length, 36.5 (33.6); palatal length, 18.5 (16.1); zygomatic breadth, 19.4 (18.2); interorbital breadth, 5.6 (5.6); breadth of brain case, 15.0 (14.3); breadth of zygomatic plate, 5.4 (5.0); length of nasals, 15.1 (13.5); length of bullae, 7.0 (6.6); occipital height of brain case, 10.5 (9.3); length of palatal foramina, 9.5 (8.5); alveolar length of upper molars, 7.4 (6.6); width M^1 , 2.1 (2.1); width across M^1 , 7.8 (7.8); greatest length of mandible, 26.4 (23.4).

This race approaches *A. c. hindei* in many respects but differs from that race in having a slightly longer foot, longer tail, less reddish pelage, longer tooth row, higher brain case, and in certain other cranial proportions.

I have examined an additional specimen from the east bank of the Loangwa (B.M. 7.1.11.52), which agrees closely with the type.

The naming of this handsome animal for Captain Guy Dollman is but poor acknowledgment of my indebtedness to that gentleman.

***Thamnomys venustus schoutedeni*, new subspecies**

TYPE.—American Museum of Natural History No. 50066. American Museum Congo Expedition No. 2407. Female adult. Collected at Medje, Ituri district, Belgian Congo, June 14, 1914, by Herbert Lang. The type is a skin with skull, both complete and in good condition.

PARATYPE.—A.M.N.H. No. 49747. Male subadult. Collected March 13, 1910, at Medje, by Herbert Lang.

GENERAL CHARACTER.—Similar to *T. venustus* of the eastern base of Mt. Ruwenzori, but with narrower nasals and muzzle, narrower molars, and longer tail.

DESCRIPTION.—The general color of the back from crown to rump, between Russet and Mars Brown. The flanks pale to Clay Color. There is no dark orbital ring. A small postauricular tuft is pure white. The hairs of the under surface are white-tipped, but their basal third is Deep Neutral Gray. The dorsal surface of the fore feet is colored as the flanks, that of the rear feet about the same though with an obsolescent dark area. The margins of both fore and hind feet are clothed in white hairs. The tail is nearly naked, except at its tip where the hairs are 2–3 mm. long. The general color of the tail is Mars Brown, above and below. The fur of this race is long and soft, in sharp contrast to the crisp fur of *T. rutilans centralis*, which is also found at Medje. However, it is slightly shorter than that of *T. v. venustus*, averaging about 12 mm. in length, dorsally, in the type from Medje, and about 15 mm. in the type from Mt. Ruwenzori.

The skull is like that of the typical race except for its long narrow muzzle, and narrower teeth.

MEASUREMENTS.—The measurements of the type are followed by the measurements of the type of *T. venustus*. When given in parentheses, the latter measurements are taken from the type description; when in brackets, they are my own measurements. Collector's measurements (those of *T. venustus* are the describer's measurements of the spirit specimen): total length, 325 (306) mm.; tail length, 203 (181); length of hind foot, 24 with claw (25 without claw); length of ear, 20 from notch (18 from ?). Cranial measurements: greatest length, 34.3 (34.5); condylo-incisive length, 30.2; basilar length, 26.0 (28); greatest breadth, 15.9 (17.2); length of nasals, 13.5 (12.5); width of combined nasals, 3.7 [4.0]; interorbital breadth, 5.0 (4.9); breadth of brain case, 13.7 (14.3); palatar length, 14.0 (15); diastema, 9.1 (9.4); palatal foramina, 7.6 (8.2); length of upper molar series, 5.7 (6.1); width M^1 , 1.7 [1.9]; condylo-incisive length of mandible, 20.4.

This race of *Thamnomys* is apparently much rarer in the Ituri than *T. rutilans centralis*, for whereas *T. v. schoutedeni* is represented in the

Congo Expedition collections by but two specimens, there are thirty-three of the other.

I am gratified to be able to associate such a handsome rodent with the name of Dr. Henri Schouteden, director of the Musée du Congo Belge, for his numerous contributions to Congo mammalogy and the innumerable courtesies extended to me while I was a visitor in his Museum.

***Thamnomys kempi major*, new subspecies**

TYPE.—American Museum of Natural History No. 82693, Ruwenzori-Kivu Expedition No. 318. Male adult. Collected at Lukuni, on the north slope of Mt. Karisimbi, central Kivu volcanoes, Belgian Congo (altitude 12,000 feet), June 17, 1927, by James P. Chapin. The type is a skin with skull, complete, though the bullae of the skull are detached. The molars are slightly worn.

PARATYPE.—A.M.N.H. No. 82694, male adult, and No. 82689, female adult, from Kabara, a site at 11,000 feet on the saddle between Mts. Mikenso and Karisimbi.

GENERAL CHARACTER.—Much larger than true *kempi*, darker, more olivaceous and less rufous than the typical race. The lips are white. The pelage is longer than that of the race of lower altitudes.

DESCRIPTION.—General color of the back Antique Brown to which the guard hairs give a slightly iridescent greenish tint in some lights. The flanks pale gradually to the Ochraceous-Buff of their lower edges. The under parts, with exceptions noted below, are white, washed with Pale Yellow-Orange. Lips, chin, and the medial surfaces of the fore and hind legs are pure white. The tip of the nose is a dark blackish brown, the mystacial and the supralabial regions, Light Orange-Yellow. Moderately long hairs clothing the upper base of the ear conch are Mars Brown, the shorter hairs of the upper half of its outer surface and all the hairs of the inner surface are Antimony Yellow. A broad stripe extending down the center of the fore leg and on to the back of the fore foot is a blackish Mars Brown, bordered with Antimony Yellow. The toes and the margins of the fore feet are white. On the center of the dorsal surface of the rear feet is an area of blackish Mars Brown. This is bordered by a band of Orange-Buff, which color extends up the midline of the foot to the ankle. As in the fore feet, the toes and margins of the furred surface of the rear feet are white. The tail is uniformly blackish brown. The hairs of its basal half are about 1 mm. long, those of its tip 4 mm.

The skull is like that of the typical subspecies, but much larger, as will be seen by the comparative measurements given below.

MEASUREMENTS.—The measurements of the type are followed in parentheses by the published measurements of the type of *T. kempi*. Collector's measurements: total length, 357 (330) mm.; tail length, 201 (189); length of hind foot, 31 with claw (27.5 without claw). Cranial measurements: greatest length, 39.3 (36); condylo-incisive length, 35.7 (32); basilar length, 30.6 (27.2); zygomatic breadth, 18.9 (16.4); interorbital breadth, 4.8 (4.7); greatest breadth of brain case, 15.4 (14.6); length of nasals, 16.7 (14.8); palatal length, 17.1 (15); length of palatal foramina, 9.5 (8.8); length of upper molar series, 7.5 (7); condylo-incisive length of mandible, 24.2.

Thamnomys kempi major is the *Hagenia* forest representative of the large tree mouse occurring at the base of the Kivu volcanoes. Count Gyldenstolpe obtained one specimen from 3900 meters (about 13,000 feet) on Mt. Karisimbi, which he noted was larger than Dollman's type of *T. kempi*.

***Thamnomys (Grammomys) surdaster callithrix*, new subspecies**

TYPE.—American Museum of Natural History No. 49789. American Museum Congo Expedition No. 1876. Male adult. Collected at Garamba, upper Uele district, Belgian Congo, March 14, 1912, by Herbert Lang. The type is a skin with skull, both in good condition. The molars are heavily worn.

GENERAL CHARACTER.—A northern representative of *T. surdaster*, differing from the typical subspecies chiefly in smaller size, and shorter muzzle.

DESCRIPTION.—General color in the middle of the back, Verona Brown, shading on the rump to a russet, near Hays' Russet (not prominent in younger specimens). The flanks are much paler than the back, and in the type are between Buckthorn Brown and Cinnamon-Rufous. A line of Apricot-Buff separates the flank color from the belly color, this line extending continuously from tip of nose to tail base. In the type it is not prominent but in less aged specimens very well marked. The hairs of the under side are Ivory Yellow from base to tip. The dorsum of the fore feet and hind feet Ochraceous Buff. The ears are lightly covered with Warm Sepia hairs. The lengthened hairs of the tail tip are this same color.

The skull is short muzzled, the zygomata lightly bowed, the supraorbital ridges well developed.

MEASUREMENTS.—Collector's measurements: total length, 270 mm.; length of tail, 160; length of hind foot with claw, 25; height of ear from notch, 18. Cranial measurements: greatest length, 28.2; condylo-incisive length, 25.4; zygomatic breadth, 14.2; interorbital breadth, 4.4; breadth of brain case, 12.3; length of nasals, 10.5; tip of nasals to anterior-superior border of infraorbital foramen, 8.0; palatal length, 12.9; length of anterior palatal foramina, 6.5; breadth of palate inside M^1 , 2.5; length of upper molar tooth row, 4.3; width M^1 , 1.4; condylo-incisive length of mandible, 17.1.

Besides the type, I refer to this species nineteen other specimens in the American Museum, collected at localities in the upper Uele (Faradje and Niangara) by the Congo Expedition, and two specimens in the British Museum. One of these, No. 21.1.8.22, is from the "Congo-Nile Watershed"; the other, No. 87.12.1.80, from Gadda, upper Uele.

***Praomys jacksoni minor*, new subspecies**

TYPE.—American Museum of Natural History No. 86816. Chapin-Edson Collection No. 2035. Male adult. Collected at Lukolela, middle Congo, July 31, 1930, by James P. Chapin. The type is a skin with skull. The left zygoma is missing and parts of the left wall of the brain case are lost or crushed. The molars are heavily worn.

PARATYPES.—A.M.N.H. Nos. 86810 (male adult), 86814 (female adult), 86818 (male adult), 86822 (female adult). All were collected at Lukolela, between July 31 and August 28, 1930.

GENERAL CHARACTER.—Differing from *P. jacksoni* as abundantly represented in American Museum collections from the Ituri and Luluabourg, Kasai, in smaller size, which extends to all of the commonly measured characters.

DESCRIPTION OF THE TYPE.—General color above near Verona Brown, though redder, paling high on the sides to Mikado Brown, which in turn shades into Cinnamon on the lower flanks. The hairs of the entire under surface are white-tipped, their bases Dark Mouse Gray in the pectoral region, lighter toward the rear. Hands and feet are white, unmarked. The eye ring is Mars Brown. Hairs on the tail are very short, scarcely visible. The tail is uniformly dark brown above and below.

The skull, as in *P. jacksoni* from other parts of the Congo, has moderately developed cuneate crests extending very nearly directly from the posterior part of the frontals to the superior orbital rim, three millimeters to the rear of the upper bar of the infraorbital foramen. The zygomatic plate projects well forward as in other true *Praomys*.

MEASUREMENTS.—Measurements of the type are followed by measurements in parentheses of a paratype (No. 86822, a female with moderately worn molars). Collector's measurements: total length, 241 (221) mm.; tail length, 136 (130); hind foot with claw, 25 [*sic*, probably 22.5] (23). Cranial measurements: greatest length, 29.2 (27.7); condylo-incisive length, 26.9 (25.1); zygomatic breadth, circa 14.0 (13.4); interorbital breadth, 4.7 (4.6); nasal length, 10.7 (10.0); nasals breadth, 3.1 (3.1); length of interparietal, 4.2 (4.1); breadth of interparietal, 8.4 (8.6); length of zygomatic plate, 3.3 (3.1); palatal length, 14.7 (13.9); diastema, 7.9 (7.6); length of upper molar row, crowns, 4.1 (4.1); breadth M^1 , 1.5 (1.5); breadth of palate inside M^1 , 2.9 (2.7); condylo-incisive length of mandible, 18.6 (17.0).

The four *Praomys* now known to occur in the Belgian Congo bear a striking resemblance. Adult specimens from the lowlands, which I have examined, are rather easily identified with one of the named forms on the basis of the assortment of characters used in the following key. The highland race, *P. j. montis* on the other hand, though averaging slightly darker and grayer than *P. j. jacksoni* of the lowlands, is better defined on geographical than on physical grounds. Members of the closely related genus *Hylomyscus*, occurring in the same area, though very similar to *Praomys* are easily told from them by their broader feet and the nature of the zygomatic plate, which is not easily visible from above.

KEY TO THE *Praomys* OF THE CONGO BASIN

- A.—Foot length 30 mm. or over; supraorbital-temporal crests weak, amphoral; tail tip naked. *P. t. lukolelae*.
- B.—Foot length less than 30 mm.; supraorbital-temporal ridges moderate or strong, cuneate; tail tip slightly hairy.
 - a.—Size small, head and body less than 116 mm.; tail less than 140, hind foot less than 24 mm., greatest length of skull less than 27 mm., upper tooth row, 4.2–4.3. *P. j. minor*.

- b.—All measurements greater than in *P. j. minor*; foot length about 26 mm., greatest length of skull about 30 mm., length of upper tooth row about 4.8 *P. j. jacksoni*.

***Praomys tullbergi lukolelae*, new subspecies**

TYPE.—American Museum of Natural History No. 86811. Chapin-Edson Collection No. 2055. Male adult. Collected at Lukolela, middle Congo, Belgian Congo, August 6, 1930, by James P. Chapin. The type is a skin with skull in good condition.

PARATYPES.—Two specimens from Lukolela, an adult female (No. 86815) and a juvenile female (No. 86823).

GENERAL CHARACTER.—Similar to *tullbergi* but with longer foot and tail, narrower interorbital area, and narrower muzzle.

DESCRIPTION.—General color in the mid line above, Russet, paling to Ochraceous-Tawny on the sides. The change to the belly coloration is abrupt. The tips of the hairs of all the under side are pale ivory through which the basal gray shows prominently. The backs of the four feet are white. The orbital ring is two to four millimeters broad and Warm Sepia in color. A broad pre- and subauricular spot is Pinkish Cinnamon. The large, almost naked ears are a dark brown. The tail, thinly clothed with minute hairs, is Snuff Brown except for the basal part of the under side of the tail which is colorless.

The skull, except for its relatively longer muzzle and lesser interorbital breadth, does not differ from *tullbergi*. The bead of the supraorbital and temporal ridges is not pronounced. The anterior margin of the zygomatic plate does not extend far forward, though more so than in species currently referred to *Hylomyscus*. The anterior palatal foramina extend backwards only to the level of the first molar.

MEASUREMENTS.—The figures in parentheses following measurements of the type are Thomas' published measurements of the type of *Mus tullbergi*. Collector's measurements: total length, 257 (108+133=241) mm. tail length, 141 (133); length of hind foot, 30 with claw (22 without claw); height of ear, 21 from notch (13.5 above crown). Cranial measurements: greatest length, 32.6; condylo-incisive length, 29.7; nasal tip to back of interparietal, 32.1 (32.3); greatest breadth, 3.7 (4.0); interorbital breadth, 5.2 (5.7); length of interparietal, 5.2 (5.2); breadth interparietal, 9.6 (9.6); palatal length, 15.9 (palate length, 17.8); diastema, 9.6 (9.8); length of upper molar row, 4.8 (crown length 4.7); breadth of M^1 , 1.5 (1.4); breadth of palate inside M^1 , 3.2 (circa 3.3); condylo-incisive length of mandible, 20.6.

The occurrence of this species at Lukolela, along with a representative of *Praomys jacksoni*, would seem to demonstrate that *jacksoni* is not a race of *tullbergi* but, as previously has been suggested, is a distinct species.

***Dendromus haymani*, new species**

TYPE.—British Museum No. 30.11.11.336. Collector's No. 136. Male adult. Collected at Mbogo (1° N. × 30° E.), Belgian Congo, March 14, 1930, by R. W. Hayman. The type is a skin with skull, the latter with an imperfect palate.

GENERAL CHARACTER.—A white-bellied *Dendromus (sensu stricto)* resembling *D. ruddi* but much lighter in color than that species. The hind feet are large, the tail long. The skull is relatively broad.

DESCRIPTION.—General color above from shoulders to tail, Tawny-Olive. The dorsal stripe commences as a broad diffuse band between the ears, which narrows and becomes very dark in the middle of the back. The stripe tapers out gently to its end at the base of the tail. A small dark spot also occurs on the crown. Around each eye is a broad light band. Above the eyes, where the bands are lightest in shade, the width is about three millimeters. The general color of the bands is a somewhat gray Pinkish-Cinnamon. The inner surface of the ear conch is clothed with hairs the color of the flanks. Hairs on the outer surface of the conch are colored like the interauricular pelage, and are conspicuously dark. A small tuft of white hair lies at the base of each ear. Fore and hind feet are white. The hairs of the under surface are white, to their bases. The tail is Sepia above, slightly lighter below.

The skull is relatively broad and has molars large for the size of the skull. The zygomatic plate also is unusually wide.

MEASUREMENTS.—Collector's measurements: head and body, 65 mm.; tail, 79; hind foot (without claw), 16; ear, 12. Cranial measurements: greatest length, 21.0; condylo-incisive length, 18.3; zygomatic breadth, 10.9; breadth of brain case, 9.7; interorbital constriction, 3.4; length of nasals, 8.5; width of zygomatic plate, 1.5; diastema, 5.2; length of palatal foramina, 4.2; width of palate across first molars, 4.6; crown length of upper molar row, 3.4; width M^1 , 1.1.

At Mboga, the De Walden Expedition obtained six specimens of *Dendromus lineatus*, two of *D. ruddi*, and but a single specimen of the form here described. Since near this locality both forest and savanna are available, it is possible that these three do not all occur in the same area. A few comparative measurements of these three species as they occur at Mboga had best be recorded here.

	<i>D. lineatus</i> 30.11.11.338 ♀ much worn	<i>D. ruddi</i> 30.11.11.333 ♀ moderately worn	<i>D. haymani</i> Type ♂ slightly worn
Condition M^1			
Head and body	60	63	65
Tail	79	82	90
Hind foot	16	17	18
Ear	12	11	12
Greatest length skull	20.0	21.1	21.0
Zygomatic width	10.6	10.8	10.9
Width brain case	9.5	10.2	9.7
Interorbital constriction	2.6	3.2	3.4
Width zygomatic plate	1.3	1.1	1.5
Diastema	5.1	4.9	5.2
Length palatal foramen	4.0	4.0	4.2
Width across M^1	4.3	4.4	4.6
Crown length upper molar row	3.1	3.2	3.5

It is a pleasure to name this tree mouse after the collector of such an interesting series.

***Steatomys pratensis kasaicus*, new subspecies**

TYPE.—American Museum of Natural History No. 86077. Male adult. Collected at Luluabourg, Kasai district, Belgian Congo, May 25, 1923, by the Reverend R. Callewaert. The type is a skin with skull. The skin is relatively greasefree and is complete except for the terminal sixth of the tail. The skull shows heavily worn molars and is complete except for the right zygoma and squamosal.

GENERAL CHARACTER.—Similar to *S. p. pratensis* but larger and slightly redder.

DESCRIPTION.—Cinnamon-Brown above, Buckthorn Brown on the lower flanks, the transition between the two, gradual. Throughout this pigmented area there are black-tipped guard hairs, uniformly distributed, and giving a faint peppery effect to the general tone. The hairs of the under side are pure white, as are also those of the hands and feet. The ears are clothed with blackish-brown hair. The dark eye ring is about 1 mm. wide and conspicuous. The upper side of the tail is near Mummy Brown, the under side white.

The skull is relatively long and narrow with small bullae and narrow palatal foramina.

MEASUREMENTS.—Collector's measurements: total length, 150 mm.; tail length, 47; length hind foot, 17. Cranial measurements: greatest length, 28.7; condylo-incisive length, 26.8; zygomatic breadth, circa 13.5; interorbital breadth, 4.3; breadth of brain case, 11.3; length of nasals, 13.3; palatal length, 14.8; length of palatal foramina, 5.6; breadth across palatal foramina, 2.6; breadth of palate across, M^1 , 6.6; length of upper molar row, 4.2; width M^1 , 1.5; condylo-incisive length of mandible, 18.3.

There are twelve skins with eleven skulls of this race in American Museum collections, all obtained at Luluabourg by Father Callewaert.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXVIII¹

NOTES ON SOME BIRDS FROM NEW BRITAIN, BISMARCK ARCHIPELAGO

BY ERNST MAYR

Mr. William F. Coultas spent the greater part of the years 1932 and 1933 in the northern and central part of New Britain and succeeded in making a collection which is far superior to any previous collection from that island. He is the first collector to undertake a thorough survey of the mountain bird life, but in addition to that he succeeded in bringing together a beautiful and practically complete collection of lowland birds including (sometimes in series) such rarities as *Henicopernis longicauda infuscata*, *Accipiter luteschistaceus*, *Accipiter brachyurus*, *Falco peregrinus ernesti*, *Habropteryx insignis*, *Columba pallidiceps*, *Henicophaps foersteri*, *Loriculus tener*, *Tyto aurantia*, *Alcyon websteri*, *Ortygocichla rubiginosa*, *Acrocephalus meyeri*, *Lonchura melaena*, and others. The collection is accompanied by very extensive field notes and individual life histories of practically all the species. An exhaustive report on the New Britain bird fauna will be given after Mr. Coultas has completed his survey of the Bismarck Archipelago, and I shall confine myself in the present paper to a description of the novelties and to a few remarks on other interesting species.

Dendrocygna arcuata (Horsfield)

Anas arcuata HORSFIELD, 1824, 'Zool. Res. Java,' part 8, Pl. LXIV, Java.

Five birds were taken between April 6 and 8, 1933, at Maulo, Wide Bay. This represents the first record of the species for New Britain. The species seems to be migratory according to Mr. Coultas' notes.

Accipiter (gentilis) meyerianus (Sharpe)

Astur Meyerianus SHARPE, 1877, Jour. Linn. Soc., XIII, p. 458, Jobi Island.

Astur planes REICHENOW, 1910, Jour. f. Ornith., LVIII, p. 412, Vuatom Island.

Accipiter planes manehi STRESEMANN, 1922, Orn. Monatsber., XXX, pp. 109-111, Seran, Moluccas.

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 623, 651, 665, and

See also: KLEINSCHMIDT, 1923, Berajah, *Falco Palumbarius*, pp. 12-15; STRESEMANN, 1924, Jour. f. Ornith., LXXII, pp. 442-443; HARTERT, 1929, Amer. Mus. Novit., No. 364, p. 5.

The only specimen of this species sent by Mr. Coultas from New Britain is in a most unusual plumage; it is melanistic, just as are some specimens of its African representative, *A. melanoleucos* (Smith) (see Bannerman, 1930, 'Birds of Tropical West Africa,' I, p. 283). Tropical goshawks, like some other tropical hawks, apparently tend to melanism.

The New Britain specimen may be described as follows:

ADULT FEMALE.—Under parts and upper parts entirely black; base of the feathers on crown, hind neck, and upper back white; axillaries and under wing-coverts black, under side of wing dark gray; white bars on under side of primaries are equally as pronounced as in the normal phase, or more so; upper tail-coverts black, with narrow but well-defined white bars and spots; the tail, which is almost uniformly colored in the normal phase, is distinctly barred. These light gray crossbars are visible not only on the under side of the outer tail-feathers, but show on the two central pairs also on the upper side.

	WING	TAIL	TARSUS	MIDDLE TOE
Kulambangra ♀ ad. (1)	322	227	78	50
New Britain ♀ ad. (2)	342	239	86	56

PROPORTIONS

	<u>Tail × 100</u>	<u>Tarsus × 100</u>	<u>Middle toe × 100</u>
	Wing	Wing	Tarsus
♀ ad. (1) normal	70.5	24.8	64.1
♀ ad. (2) melanistic	69.9	25.2	65.1

The foot of *meyerianus* is relatively large, as seen by the middle toe-tarsus index, the long-toed *Accipiter brachyurus* (a representative of *A. nisus*) being the only hawk on New Britain or the Solomon Islands, which has a relatively longer middle toe. This is another bit of evidence to show the impossibility of upholding the genus *Astur*, whose main character in the Palaearctic and Nearctic forms is the relative shortness of its toes.

Melanistic specimens of *Accipiter melanoleucus* never seem to become entirely black (see Kleinschmidt, 1923, Berajah, *Falco Palumbarius*, Pl. XIII), there is some white retained at least on chin and upper throat, while the entire body plumage becomes black in *meyerianus*. It is remarkable, however, that the bars on wing and tail appear more pronounced in the melanistic specimen of *meyerianus* than in the specimen in the normal phase.

Accipiter princeps, new species

TYPE.—No. 417430, Amer. Mus. Nat. Hist.; ♂ ad.; Balayang (2500 ft.), Wide Bay, New Britain; Feb. 12, 1933; W. F. Coultas.

ADULT MALE AND FEMALE.—Entire upper side slate-gray, wing and tail darker, tips of primaries and under side of tail almost blackish; sides of head and of neck light slate-gray; middle of throat, breast, belly, flanks, and under tail-coverts white; breast, particularly the sides of the breast, with a slight grayish wash, sometimes in the form of an indistinct vermiculation; axillaries and under wing-coverts white, occasionally with a few grayish crossbars; tail-feathers uniform, without any light bars; inner webs of the wing-feathers near the base white with a gray mottling; the four outermost wing-feathers slightly emarginated on the inner web; wing-formula $5 > 4 > 3 > 6 > 2$, or $4 > 5 > 3 > 6 > 2$. "Iris, bright orange to flesh-orange; cere, reddish orange; bill, black, base of the lower mandible, orange; feet yellow-orange."

	WING	TAIL	TARSUS	MIDDLE TOE
New Britain ♂ ad. (1)	257	186	71	36
♂ ad. (2)	253	183	68	38
♀ ad.	285	207	70	38

I add a list of size proportions which will help in a comparison of this species with others from the same region.

		Tail × 100	Tarsus × 100	Middle Toe × 100
		Wing	Wing	Tarsus
<i>poliocephalus</i>	♂ ad.		28.9	53.5
	♀ ad.	72.4	31.0	49.2
<i>princeps</i>	♂ ad. (1)	72.4	27.6	50.7
	♂ ad. (2)	72.3	26.9	55.9
	♀ ad.	72.6	24.6	54.3
<i>sharpii</i>	♂ ad.	70.3	27.5	57.4
	♀ ad.	73.0	26.6	58.8
<i>albogularis</i>	3 ♂ ad.	70.6	28.5	56.8
	4 ♀ ad.	72.7	26.9	61.4
<i>luteoschistaceus</i>	3 ♂ ad.	76.2	32.7	61.2
<i>brachyurus</i>	3 ♀ ad.	71.4	30.7	71.4

This table reveals at once that the proportion of tail and wing is approximately normal in this species, while the tarsus is extremely short, and the middle toe very short.

A comparison of the new species with all the other species of *Accipiter* recorded from the Melanesian and Papuan regions shows that it resembles only one, namely *Accipiter poliocephalus* from New Guinea and surrounding islands. The new species differs, however, in so many characters that it seems to be advisable to regard it for the time being as a separate species, particularly so long as the immature plumage is unknown.

Accipiter princeps differs from *poliocephalus* by being much larger; by having head and sides of the head as dark gray as the mantle, not lighter; by having the second primary shorter than the sixth, not longer; by having the base of the tail-feathers slightly sprinkled with white, not distinctly barred; by having broad tail-feathers, not narrow ones; by having much less white on the under side of the wing; by having the four outer wing feathers less distinctly emarginated; and by having a relatively shorter tarsus and much stronger feet. The toes are reticulate, not scutellate, but a tendency toward this can also be found in *poliocephalus*.

RANGE.—Inland of Wide Bay, New Britain, Bismarck Archipelago.

MATERIAL EXAMINED.—2 ♂ ad., Feb. 12 and Feb. 21, 1933, Bala-yang, Baining Mountains, 2500 ft.; 1 ♀ ad., May 10, 1933, Timoi-p Mountains, 3600 ft.

***Ducula melanochroa* (Sclater)**

Carpophaga melanochroa SCLATER, 1878, Proc. Zool. Soc. London, p. 672, Pl. XLII, Duke of York Islands.

Mr. Coultas has sent a fine series of this rare mountain species, of which Hartert says correctly: "It has no close ally, and stands by itself" (1925, Nov. Zool., XXXII, 117). The bird resembles superficially *Ducula pinon* of New Guinea, particularly in having light edges on the upper wing-coverts. It differs, however, in lacking the bare space around the eye, in its much weaker feet, and in the absence of a tail-band.

***Columba pallidiceps* (Ramsay)**

Janthoenas pallidiceps RAMSAY, 1877, Proc. Linn. Soc. New South Wales, II, p. 248, Duke of York Islands.

Janthenas philippinae RAMSAY, 1881, Proc. Linn. Soc. New South Wales, VI, p. 721, Ugi, Solomon Islands.

A small series of the yellow-legged pigeon from New Britain agrees well with a series from the Solomon Islands. *Janthenas philippinae* was based by Ramsay on purely individual differences. The metallic gloss is of a different color in almost every specimen.

I have already pointed out in a previous paper (1931, Amer. Mus. Novit., No. 504, p. 10) that this is a distinct species, not a representative of *vitiensis*, as believed by Hartert (1925, Nov. Zool., XXXII, p. 118). *Columba vitiensis* apparently has never been recorded from New Britain, but both species occur together on some islands in the Solomon Islands. Considering the uncertainty of the specific status of *pallidiceps* and *vitiensis*, it may be worth while to give a key of their characters.

- 1.—Feet yellow, entire head light gray *pallidiceps*.
 2.—Feet red, upper throat white, upper head slate-gray with metallic gloss.
vitiensis halmaheira.

***Gymnophaps albertisi albertisi* Salvadori**

Gymnophaps albertisi SALVADORI, 1874, Ann. Mus. Civ. Genova, VI, p. 86, Andai, Arfak Mountains, New Guinea.

This species has already been reported from New Britain by Rev. O. Meyer, but I am not sure whether any specimens have ever reached any museum. Mr. Coultas sent a fine series from the Nakanai Mountains and from the mountains back of Wide Bay. These birds can not be separated with certainty from typical New Guinea birds. New Britain birds are on the average more white on the breast (with less of the pinkish buff wash), more gray on the upper throat (the gray frequently forming a band across the throat), and with a distinctly grayish wash in the chestnut zone of the upper belly. The measurements average slightly larger than those of New Guinea birds, but there is considerable overlap. I am not following the fashion of those ornithologists who describe new subspecies on the basis of such slight size differences.

		WING		WING
New Guinea	11 ♂	193-214 (202.8)	5 ♀	198-205 (202 5)
New Britain	16 ♂	204-219 (213.6)	12 ♀	195-219 (205 2)
Batjan	4 ♂	219-234 (225 2)	4 ♀	208-227 (219 5)

The measurements of the Batjan series (kindly supplied by Prof. Stresemann) prove that the birds from the northern Moluccas are consistently larger, as correctly pointed out by Hartert in the original description of *ersul*.

In skins, the lores and the bare space around the eye are sometimes red and sometimes yellow. This variation, however, is entirely due to the manner of preparation and drying. These parts are always entirely coral red in living birds.

***Streptopelia chinensis tigrina* (Temminck)**

Columba tigrina TEMMINCK, 1811, 'Pigeons,' I, Pl. XLIII, Java.

This is the first record for this dove on New Britain. It has been introduced apparently only very recently, presumably by some Malays from the Moluccas where the bird is frequently kept in captivity.

The three specimens collected by Mr. Coultas agree perfectly with specimens from the Sunda Islands, except that lower abdomen and under tail-coverts are rather buffy, not whitish.

Chalcophaps stephani stephani Pucheran

Chalcophaps stephani PUCHERAN, 1853, 'Voy. Pôle Sud,' III, (Zool.), p. 119, Pl. xxviii, fig. 2, Triton Bay, New Guinea.

A small series of this ground dove was very welcome for comparison with New Guinea birds.

		WING		WING
New Britain (Coultras Coll.)	8 ♂ ad.	135-114 (141.0)	2 ♀	136, 139
New Guinea (Beck Coll.)	6 ♂ ad.	140-146 (143 2)	1 ♀	140

These measurements show that birds from New Britain average slightly smaller than New Guinea specimens. The subspecies from the Solomon Islands (*mortoni*) is considerably larger (wing up to 154).

Loriculus tener Sclater

Loriculus tener SCLATER, 1877, Proc. Zool. Soc. London, p. 107, Duke of York Islands.

Mr. Coultas brought back two specimens of this rare parrakeet, one from the neighborhood of Rabaul and the other from the Wide Bay. I have found no records that this species has ever been taken before on New Britain. It is known from the Duke of York Islands, New Ireland, and New Hanover.

Eurystomus orientalis crassirostris Sclater

Eurystomus crassirostris SCLATER, 1869, Proc. Zool. Soc. London, p. 121, "Solomon Islands," correctly: New Ireland. (See Sharpe, 1890, Proc. Zool. Soc. London, p. 552, and Mayr, 1933, Ibis, p. 551.)

Eurystomus neohanoveranus HARTERT, 1901, Nov. Zool., VIII, p. 185 (footnote), New Hanover.

The geographical variation of this roller has not been understood so far and almost every new form has been described with some misapprehension. To begin with, *crassirostris* Sclater was based on a single specimen of doubtful origin, and the type apparently has been lost. It was obviously a very badly preserved specimen with the colors much altered by alcohol. This explains the characters given in the original description and later mentioned by Elliot (Ibis, 1871, p. 204).

Eurystomus waigiouensis Elliot was compared with this single pitiful specimen of *crassirostris* and of course was found to differ. Salvadori, however, and all the authors after him, assumed that New Guinea birds were identical with New Britain birds and synonymized

waigiouensis with *crassirostris* (*auctorum*, *nec* Sclater) since the Waigeu type did not differ from New Guinea birds.

Hartert committed the same error when he described the New Hanover bird as new. He had no material from New Ireland or New Britain and therefore compared his birds only with the Solomon Island subspecies, *solomonensis*. He says (*op. cit.*, p. 185): "It differs from *E. solomonensis*, which it resembles most, in the more uniform and more purplish gular patch, on which the shaft-lines are much less developed. The blackish forehead has a distinct purplish tinge, which is not visible in *E. solomonensis*; the hind neck and mantle are more bluish green, less tinged with blackish brown." And later he says (1924, Nov. Zool., XXXI, p. 206): "This form differs from *E. o. crassirostris* (New Guinea and New Britain) in the more purplish crown, more bluish back; the light shaft-lines on the throat are less conspicuous, and the black tip on the bill is more restricted and (in one) even absent." Obviously, however, he had at that time no specimens from New Ireland or New Britain, since New Britain birds differ from New Guinea and from Solomon Islands birds by the very characters mentioned by Hartert as peculiar to New Hanover birds. Hartert himself seems to have noticed this when he finally received some material from New Britain (1926, Nov. Zool., XXXIII, p. 137). He admits that *neohanoveranus* is probably not valid, but he fails to distinguish clearly the characters of the New Britain and New Guinea birds.

Since the differences between adult birds of the two islands apparently have never been clearly stated, I should like to give below a short diagnosis of *crassirostris* Sclater, based on New Britain specimens, which are obviously not at all different from New Hanover birds. New Britain birds differ from New Guinea birds by being much more bluish all over the body. They lack, on hind neck, back, upper wing-coverts, and breast, the greenish-brown tone of New Guinea birds. Forehead and crown are darker and with a distinct bluish wash, not fuscous with a greenish or brownish tinge. The ear-coverts also are noticeably washed with ultramarine blue. The streaking of the throat is more or less obsolete, the throat patch thus gaining a more uniform purplish appearance. The extension of black on the culmen of the maxilla is much less, on the average, than in New Guinea birds; in a few specimens the black is entirely missing.

It is clear from this discussion that it is wrong to use the name *crassirostris* Sclater for New Guinea birds. They can be called *waigiouensis* Elliot since we have no evidence so far that the birds from the

western Papuan Islands are different from the birds found on the New Guinea mainland. Further revisional work is necessary to show whether or not there are any differences between birds of eastern and western New Guinea.

Rhyticeros plicatus

The study of the individual and geographical variation of this species has been greatly neglected up to recent years. It was assumed that there was no difference between birds from the New Guinea region, the Bismarck Archipelago, and the Solomon Islands. However, in 1924 Hartert described the bird from Guadalcanar, Solomon Islands, as a distinct subspecies and thus opened up the field for a more detailed investigation. The rich material gathered by the Whitney South Sea Expedition permits new conclusions to be drawn concerning the geographical variation in this species. It seems that there are at least four well-defined subspecies in the range outlined above, differing in size, in the shape of the bill, and in the coloration of the neck of the male.

Rhyticeros plicatus ruficollis (Vieillot)

Buceros ruficollis VIEILLOT, 1816, 'Nouv. Dict. d'Hist. Nat.,' Nouv. Éd., IV, p. 600, Waigeu Island.

SUBSPECIFIC CHARACTERS.—Large, with a heavy bill; neck of the male rufous ochraceous.

	WING	TAIL	BILL ¹	PLEATS ²
8 ♂ ad.	437, 443, 443	255, 256, 258	210, 212, 216	6, 6, 6.5
	444, 447, 450	260, 264, 266	223, 223, 224	7, 7, 7
	454	268, 269	225, 227	7, 8
3 ♂ (ad.)	432, 443, 447	252, 262, 264	185, 198, 199	2, 2, 3
3 ♂ imm.	398, 405, 410	240, 242	145, 163, 174	1, 1, 1
1 ♀ ad.	441	(221)	167	5
3 ♀ imm.	394, 395, 398	233, 236, 241	148, 161, 170	1, 1, 3

RANGE.—Northern Moluccas, western Papuan Islands, New Guinea, Japan, and D'Entrecasteaux Archipelago.

It is doubtful whether the birds of the range outlined above form a uniform population. I have not seen enough material from western New Guinea, the western Papuan Islands, and the northern Moluccas. Unfortunately, most of the published descriptions and measurements are quite useless, since the authors did not keep apart the ages or sexes. However, birds from the northern Moluccas seem to have the neck darker in the male plumage than New Guinea birds, thus approaching

¹Measured from the anterior edge of the nostril to the tip.

²Number of pleats on the casque.

plicatus (Forster) from Seran (southern Moluccas). Birds from the western Papuan Islands (including the type-locality, Waigeu) apparently agree in coloration with New Guinea birds, but there is the possibility of a size difference, in which case the New Guinea race would require a new name. The New Britain bird, however, is decidedly different.

***Rhyticeros plicatus dampieri*, new subspecies**

TYPE.—No. 333346, Amer. Mus. Nat. Hist.; ♂ ad.; Baining Mountains, New Britain; Aug. 30, 1932; W. F. Coultas.

SUBSPECIFIC CHARACTERS.—In coloration somewhat similar to *Rhyticeros plicatus ruficollis* Vieillot, but much smaller and with a shorter and slenderer bill; naked area on throat apparently less extended; color of neck (in the male plumage) darker, rufous chestnut on the hind neck, thus approaching *plicatus*; differs from *mendanae* Hartert, which it approaches in proportions, in the dark and rich coloration of neck and breast, parts which are very pale in *mendanae*.

	WING	TAIL	BILL	PLEATS
1 ♂ ad.	407	244	183	6.5
1 ♂ imm.	387	208	150	1
2 ♀ ad.	—, 372	212, 224	137, 144	4.5

RANGE.—New Britain, New Ireland, and New Hanover, Bismarck Archipelago.

The material collected by Coultas is sufficiently large to show that this is a small subspecies. More specimens, however, must be collected before it can be decided whether or not the measurements overlap with those of *ruficollis* Vieillot.

The adult male has some abnormal white feathers on the upper wing-coverts and on the back.

***Rhyticeros plicatus harterti*, new subspecies**

TYPE.—No. 220992, Amer. Mus. Nat. Hist.; ♂ ad.; Bougainville Island, Solomon Islands; Jan. 30, 1928; F. P. Drowne.

SUBSPECIFIC CHARACTERS.—In coloration indistinguishable from *mendanae* Hartert, but much larger, and with a longer and heavier bill.

		WING	TAIL	BILL	PLEATS
Fauro and Shortland					
Is.	♂ ad.	409, 400	237, 235	199, 200	4.5, 5
	♂ (ad.)	410	246	181	3
	♀ ad.		229	153	6
Bougainville	♂ ad.	428	249	200	7
	♀ ad.	392	225	163	6
Buka	♂ ad.	412, 418	241, 244	196, 212	5, 5
	♀ ad.	394	225	160	5

RANGE.—Bougainville, islands of Bougainville Straits (Fauro and Shortland Islands), and Buka, northern Solomon Islands.

I name this form in honor of the late Dr. Ernst Hartert, who did more than anybody else to advance the knowledge and better understanding of the bird fauna of the Solomon Islands.

Birds from the islands of Bougainville Straits average slightly smaller, but they have larger bills than any specimen of *mendanae* Hartert.

***Rhyticeros plicatus mendanae* Hartert**

Rhyticeros plicatus mendanae HARTERT, 1924, Bull. Brit. Orn. Club, XI.V, p. 46, Guadalcanar, Solomon Islands

SUBSPECIFIC CHARACTERS.—Very small form with a short, slender bill; neck and throat in the male very pale, almost straw-colored.

		WING	TAIL	BILL	PLEATS
Guadalcanar	♂ ad.	407, 394, 395	237, 234, 238	177, 166, 163	7, 6, 4.5
		385, 393, 382	237, 231, 221	163, 182, 166	4.5, 5, 5, 6
	♂ (ad.)	377	228	157	3
	♂ imm.	373	224	141	1
	♀ ad.	379, 373, 369	212, 210, 208	148, 150, 135	6, 6, 8
Malaita		365, 374	210, 221	146, 147	4.5, 5
	♂ ad.	396, —, 405	244, 250, 255	178, 174, 180	6, 5, 5
		399	238	173	5
Ysabel	♀ ad.	380	222	133	6
	♂ ad.	392, 404	231, 236	186, 176	6, 6
	♂ imm.	376, 390	224, 228	143, 151	1, 1
	♀ ad.	359, 382	210, 214	139, 146	5, 6
	♀ imm.	354	210	131	1
Choiseul	♂ ad.	—, 389, 377	241, 227, 215	173, 176, 166	—, 6, 5
		382, 387, 393	223, 226, 224	181, 185, 176	5, 5.5, 5.5
		400	229	194	6
	♂ (ad.)	402	233	162	2.5
	♂ imm.	372	212	135	1
	♀ ad.	366	208	145	5
	♀ (imm.)	354, 366	202, 203	127, 137	3, 3
		365, 358	208, 208	147, 136	2, 1
Vangunu	♂ imm.	382	221	158	1

RANGE.—Choiseul, Ysabel, Malaita, Guadalcanar, and Vangunu, Solomon Islands.

This species has a curious distribution on the Solomon Islands. It is completely absent from San Cristobal and neighboring islands, and seems to be absent also from the Central Solomon Islands. One specimen from Vangunu is the only record from that group.

The birds from the five islands listed do not form a uniform population. Birds from Malaita average larger, and birds from Choiseul Island

seem to have a particularly small tail. As a group, however, they are visibly smaller than *harterti* from the northern Solomon Islands.

The examination of a large series of specimens of this species gave me a good opportunity to study the growth of the pleats on the bill. The Malay name of this hornbill is "burung tahun," meaning year-bird. The natives believe that the bird acquires one additional pleat on its casque every year. There has been considerable argument among ornithologists as to whether this is true, but Stresemann has shown rather definitely that this belief is erroneous (1914, Nov. Zool., XXI, p. 99). The extensive tables of measurements published above show conclusively that males in the immature plumage have an undivided casque (indicated in my tables as "1"). Birds with a fully adult plumage, but with a still growing bill, have either two or three pleats: these birds are indicated as "♂ (ad.)" in my tables. Adult birds with a fully grown bill have four and one-half to eight pleats, but I am not at all sure that birds with many pleats are older than those with few. Some of my specimens with the largest bills have the fewest pleats on the casque, and vice versa. The outermost pleat, furthermore, breaks off easily, as shown by Stresemann (*loc. cit.*) and as also substantiated by my material. Conditions in females are somewhat more difficult, and I need more material before I can distinguish definitely between immature and semi-adult "(ad.)" female birds.

I wish to call attention to the specimens in the "(ad.)" plumage. They have perfectly adult coloration and can not be distinguished from fully adult birds except by their measurements, particularly those of the bill. The number of pleats on the casque is two or three. These specimens are obviously in their first adult year, and permit the interesting conclusion that adult birds can keep on growing after reaching maturity. This is quite obvious for the bill and also, in minor degree, is true for wing and tail. It can be seen from the above listed measurements that birds in the "(ad.)" plumage average smaller in regard to wing and tail than birds in the fully adult plumage. There has been some disagreement as to whether birds always reach their full size in their first completely adult plumage. The evidence in this case points to the contrary.

Hirundo tahitica

Looking over the publications on the birds of the Bismarck Archipelago I find that sometimes *Hirundo tahitica* (= *subfusca* Gould), sometimes *Hirundo javanica* (= *frontalis* Quoy and Gaimard), and sometimes even both species are listed as occurring on New Britain. This

situation was not disturbing so long as both forms were regarded as distinct species, but after Stresemann had united them quite correctly into one species, some explanation had to be found. Stresemann (1923, Arch. f. Naturg., LXXXIX, A8, p. 25) records *tahitica* as the form living on New Britain (following Sharpe, 1885, 'Cat. Birds,' X, p. 143), adding that specimens with white in the tail sometimes occur in the range of that form, while Hartert on the contrary (1926, Nov. Zool., XXXIII, p. 139), calls the New Britain form *Hirundo tahitica frontalis* and expresses the opinion that *Hirundo tahitica* probably occurs only as a straggler.

Considering this conflict of opinions, I emphasized to Mr. Coultas the necessity for collecting in New Britain a series of swallows, with the gratifying result that I have now before me fifteen specimens, a sufficient number to settle the argument. The truth of the matter is that New Britain is inhabited by an unrecognized form with a high degree of individual variation, a form which in most of its characters is intermediate between *frontalis* and *subfusca*.

Hirundo tahitica ambiens, new subspecies

TYPE.—No. 417431, Amer. Mus. Nat. Hist.; ♂ ad., Wide Bay, New Britain; Jan. 10, 1933; W. F. Coultas.

SUBSPECIFIC CHARACTERS.—Similar to *Hirundo tahitica subfusca* Gould, but averaging smaller; breast and belly lighter and less brownish, edges of feathers whitish, not buff; fewer or no feathers with glossy black centers in the middle of breast and abdomen; glossy black centers of under tail-coverts less pronounced; two-thirds of the specimens with white on the tail, while in *subfusca* the tail is usually entirely black, only every sixth specimen having a small, scarcely noticeable light shading on the fifth tail-feather; tertials frequently with narrow buffy edges, which are absent in *subfusca*; differs conspicuously from *frontalis* in larger size, comparatively longer tail, much darker under parts, and the reduced amount of white in the tail.

Iris dark brown, bill and feet black.

	WING	TAIL	TAIL-WING INDEX
8 ♂	109-113 (110 3)	49-52 (50 9)	46 1
7 ♀	103-110 (106 7)	47-50 (48.7)	45 6

RANGE.—Bismarck Archipelago.

The molting period seems to cover more than four months. I have a completely molted specimen from the second week of January and a specimen in full molt from April. Two other April birds however, have, already completed the molt.

A comparison of the New Britain series with neighboring races reveals at once its general similarity with *subfusca*. The extreme variability of the amount of white in the tail suggests the possibility that *ambiens* is a hybrid population between *frontalis* and *subfusca*. How-

ever, size and general characters of coloration are fairly constant, and it seemed to be advisable to name this well-characterized population in spite of the fact that a few of the specimens (among those without any white in the tail) are barely different from *subfusca*.

The species *Hirundo tahitica* is badly in need of a revision, but this can not be done so long as this common bird is neglected by the collectors. A few remarks on the material before me may help in future work.

Hirundo tahitica tahitica Sparrman is restricted to the Society Islands and differs from *subfusca* Gould fundamentally in many characters. It is by far the most peculiar form of the species, and the rarity of specimens is the only excuse for the fact that *subfusca* Gould has always been synonymized with it.

Hirundo tahitica subfusca Gould.—This form ranges from Central Polynesia to the New Hebrides and the Solomon Islands without any obvious geographical variation in this area. This Polynesian form, (together with *tahitica* Sparrman) will be treated in detail at a later date. I content myself at present with recording some measurements from the type locality (Moala Island) and some of the adjoining islands.

	WING	TAIL	TAIL-WING INDEX
6 ♂	110-115 (112.3)	49-51 (49.8)	44 3
9 ♀	109-113 (111.2)	47-50 (48.5)	43.6

Hirundo tahitica frontalis Quoy and Gaimard [type locality: Dorey (Manokwari), northwestern New Guinea].—This form is supposed to range from Celebes and the Lesser Sunda Islands eastward to New Guinea and neighboring islands. However, the birds included in this range do not seem to form an entirely uniform population. Birds from eastern and southern New Guinea and from the islands of Torres Straits are apparently lighter underneath, average smaller, and have larger white spots on the tail than typical birds. This has been noticed already by Sharpe (1885, 'Cat. Birds,' X, p. 143). Birds from the Lesser Sunda Islands and from Celebes agree in coloration with typical *frontalis* (wing, 104-110 mm.), but average smaller (wing, 97-108 mm.). This size difference seems too irrelevant to recognize *viridissima* Meise. Rensch (1931, Mitt. Zool. Mus. Berlin, XVII, p. 549) has already pointed out that the color characters (greenish gloss of the upper parts), which Meise attributes to his "new" form, are not valid. I have examined some of Meise's paratypes, and agree with Rensch's conclusion. The gloss of the upper parts is extremely variable in this species and is entirely determined by the amount of wear. Freshly molted birds have a distinctly greenish tinge, which turns steel-blue later in the season, and purplish in worn specimens.

***Cisticola exilis polionota*, new subspecies**

TYPE.—No. 332816, Amer. Mus. Nat. Hist.; ♂ ad., summer dress (testes large); Baining District, New Britain; June 21, 1932; W. F. Coultas.

SUBSPECIFIC CHARACTERS.—Similar to *diminuta* Mathews, but paler and much less rufous; edges of the feathers of the back distinctly grayish, with practically no ochraceous tinge; back consequently in sharp contrast with the orange-ochre crown and the dull ochre rump; crown in many breeding males with well-marked diffuse black shaft-streaks, while in *diminuta* the crown is usually without any shaft-streaks; under parts, particularly in specimens in the winter dress, much paler, with the rufous wash replaced by a pale ochraceous wash; rufous nuchal collar in females and winter males much less pronounced; juvenals quite different; under side very rich sulphur-yellow, upper parts with a strong pale greenish gray, instead of rufous ochraceous, wash.

	WING	TAIL
♂ ad. (summer)	46-48 (46.8)	32-36 (34.0)

RANGE.—New Britain; most likely also New Ireland and New Hanover.

I thought I would have no trouble with this genus, which is better monographed than any other group of birds. However, I was mistaken! I have examined eighty-eight specimens from Queensland, New Guinea, the D'Entrecasteaux Archipelago, and New Britain, and come to conclusions that differ widely from those of Admiral Lynes. I am now waiting for the examination of the Tring material, and for additional collections (on the way from New Guinea and the Bismarck Archipelago) before I attempt to publish my unexpected findings. I take this opportunity to thank Prof. E. Stresemann, Mr. James Greenway, and Dr. Herbert Friedmann for their kindness in lending me specimens from the Zoological Museum in Berlin, the Museum of Comparative Zoölogy in Cambridge, and the United States National Museum in Washington.

***Monachella mülleriana coultasi*, new subspecies**

TYPE.—No. 417432, Amer. Mus. Nat. Hist.; ♂ ad.; Andomgi River (2500 ft.), Wide Bay, New Britain; April 14, 1933; W. F. Coultas.

SUBSPECIFIC CHARACTERS.—Similar to *mülleriana* (Schlegel), but much darker; under parts not pure white, but light gray on breast, upper belly, flanks, and under tail-coverts; lower belly and under tail-coverts in some specimens buffy; entire back gray, not set off by a whitish collar from the brownish-black crown; rump scarcely lighter than back; upper tail-coverts blackish or dark gray, not white; axillaries and thighs gray, not whitish; size apparently as in *mülleriana* (Schlegel).

	WING	TAIL
4 ♂ ad.	92-96 (93.0)	58-60 (59.0)
4 ♀ ad.	91-93 (92.0)	56-60 (57.8)

Culmen, 16; tarsus, 16.

RANGE.—Hinterland of Wide Bay, New Britain.

It gives me great pleasure to name this highly interesting new form in honor of Mr. William F. Coultas, who did so much to further our knowledge of the bird life on New Britain. The discovery of this river chat on New Britain is certainly a most unexpected addition to the bird fauna of that island. The species was known previously only from the mainland of New Guinea where it showed no geographical variation. It is doubtful whether this weak-footed species is really so close to *Poecilodryas* as is generally supposed.

NOTES AND DESCRIPTIONS OF AFRICAN DIPTERA

BY C. H. CURRAN

A number of the species described in this paper were collected by Prof. T. D. A. Cockerell and party during their visit to Africa a few years ago, while others were received from Mr. Alexander Cuthbertson or collected during museum expeditions. The types are in The American Museum of Natural History.

MYDAIDAE

Three species were collected by Dr. Cockerell and party.

***Leptomydas nivosus* Gerstaecker**

GERSTAECKER, 1868, Stett. Ent. Zeitg., XXIX, p. 83.

Male, Nieuwoudtville, Cape Province, November 20 (J. Ogilvie).

***Leptomydas humeralis* Gerstaecker**

GERSTAECKER, 1868, Stett. Ent. Zeitg., XXIX, p. 82.

Male, Calvinia, Cape Province, November 12 (T. D. A. Cockerell).

***Nomoneura partita* Gerstaecker**

Cephalocera partita GERSTAECKER, 1868, Stett. Ent. Zeitg., XXIX, p. 80.

Male and female, Calvinia, Cape Province, November 14, 16 (Alice Mackie).

The male agrees with Gerstaecker's description except that the veins of the wings are bordered with brown, the posterior border cinereous, and the veins are brown, instead of being luteous. It seems likely that the original description was based on a specimen with faded wings. The female is black and has only black hair on the head and abdomen. The legs are reddish, the femora reddish brown, the posterior pair mostly blackish. The two sexes undoubtedly belong together.

It is impossible to be certain of the identity of the specimens placed here and I had considered them as representing an undescribed species. They are much larger than *callosa* Wiedemann (measuring 13 and 15 mm.) and disagree in having the base and apex of the abdomen black. Wiedemann's description calls for a species in which the male has brownish-yellow abdomen, but as recognized by Bezzi the abdomen is brownish or

black and I doubt the correctness of the determination. *N. callosa* is said to have white hair on the back of the head in the male, but in Bezzi's examples the hair was described as brownish; in the male and female before me it is yellowish on the face and front and black on the occiput in the male and all black in the female. It seems likely that there are several distinct species related to *callosus* or all the forms represent a single variable species and the matter can only be cleared up by the examination of abundant material and the comparison of the male genitalia.

ASILIDAE

NEOLAPARUS Williston

I have not been able to include all the African species referred to this genus in the following key as the descriptions are not always sufficiently detailed to permit using important characters.

TABLE OF SPECIES

- 1.—Two oral bristles.....2.
Four or six oral bristles.....13.
- 2.—Third antennal segment clubbed, small basally.....4.
Third antennal segment elongate and with almost parallel sides, with very few hairs above.....3.
- 3.—Face shining, pale yellow, with an oval black spot on the upper half (Congo).
longicornis Curran.
Face yellow, without black spot; oral bristles yellow.....23.
- 4.—Wings rich brown, the cells sometimes paler.....5.
Wings at most pale brownish or tinged with brown.....6.
- 5.—Antennae mostly reddish, the third segment largely brown, the first sometimes mostly reddish brown; legs of male with thick hair...*moerens* Wiedemann.¹
Antennae black.....*morio* Bezzi.
- 6.—Front with black or brown spot or mostly dark.....7.
Face and front yellow; oral bristles white; legs yellowish brown, slender; abdomen brownish red, the second and third segments yellow...*gracilipes* Loew.
- 7.—Front brassy yellow pollinose with small black spot above the antennae; abdomen reddish, with lateral pollinose spots.....*pulchriiventris* Loew.
Front not brassy yellow except laterally, if somewhat so the abdomen extensively pollinose and not reddish.....8.
- 8.—Face reddish brown in ground color and yellowish pollinose, twice as high as wide.....9.
Face reddish or yellow in ground color, or white pollinose.....10.
- 9.—Black mesonotal vitta greatly narrowed in front and behind....*ophion* Speiser.
Black mesonotal vitta but little narrowed in front and behind...*holotaenia* Speiser.
- 10.—Face with yellow hairs.....11.
Face with black hairs, brownish yellow in ground color.....24.

¹Cf. *pedunculatus* Loew.

- 11.—Prothorax with blackish spot above or almost wholly black in ground color. . 12.
Prothorax wholly pale *oralis* Van der Wulp.
- 12.—Prothorax almost wholly black in ground color, yellow pollinose; abdomen
black, with gray pollen *bivittatus*, n. sp.
Prothorax reddish yellow with black spot above, the pollen yellowish; abdomen
reddish *similis* Curran.
- 13.—Oral setae black 14.
Oral setae whitish or yellowish 18.
- 14.—Abdomen reddish, the first segment black; scutellum black with white pollinose
border *caliginosus* Loew.
Abdomen much more extensively black 15.
- 15.—Wings dark brown; second and third abdominal segments mostly reddish.
 *funestus* Loew.
Wings at most pale brownish; abdomen usually wholly black or brown . . 16.
- 16.—Wings hyaline *clausus* Loew.
Wings distinctly brownish 17.
- 17.—Base of wings broadly sub-hyaline *squalidus* Loew.
Wings evenly pale brownish, with lighter or darker apex 22.
- 18.—Four oral bristles 19.
Six strong oral bristles 21.
- 19.—Abdomen black, with red fasciae *banana* Curran.
Abdomen ferruginous or black 20.
- 20.—Abdomen ferruginous, the first segment with a black spot. . *aulicus* Wiedemann.
Abdomen black *melasomus* Loew.
- 21.—Antennae brownish yellow, the third segment darker *laticornis* Loew.
Basal antennal segments blackish *bicolor* Loew.
- 22.—Middle of face wholly shining brown *albicinctus* Ricardo.
Face pale yellow pollinose *tabidus* Loew.
- 23.—Abdomen wholly black *apertus* Karsch.
Abdomen blackish with reddish-brown spots and gray pollinose segmentations.
 *angusticornis* Ricardo.
- 24.—Abdomen with pollinose bands on basal segments *silaceus* Hermann.
Abdomen without pollinose bands *cuneatus* Loew.

***Neolaparus bivittatus*, new species**

Black with olive-gray pollen; legs mostly reddish; face with white pile. Length, about 18 mm.

MALE.—Face yellow in ground color, whitish pollinose with yellow tinge in the middle; oral bristles whitish, the face with numerous fine, yellowish-white hairs, not wider than long. Front brown in ground color, densely yellowish pollinose, becoming darker above. Occiput white pollinose and white pilose, above with brownish pollen and yellow pile, the pair of bristles yellowish, a few of the hairs behind the vertex brown. Palpi black; bearing black hair. Antennae pale brownish, the second segment, tip of the first and base of the third, reddish yellow, the hair black above, whitish below; third segment clavate.

Thorax blackish in ground color, the humeri yellow; pleura with whitish pollen which becomes yellowish above. Mesonotum with rather olive-yellow pollen leaving

a pair of entire dark brown vittae, clothed with rather long, fine, yellowish-white hair, that in front of the scutellum black; pleura with white hair. Scutellum dark brown with pale border, the apex brownish, the sides white; hair black.

Legs reddish, the femora and anterior and posterior tibiae brown above; hair black, dense and forming lateral fringes on the apical half or more of the posterior four tibiae and on their tarsi, the bristles yellowish white; tarsi brown; coxae white pollinose and pilose.

Wings cinereous hyaline; squamae yellow; halteres pale yellow, with brown knob.

Abdomen blackish in ground color, cinereous pollinose on the sides, becoming brownish on the disc, on the second to fourth segments the gray pollen forming broad basal cross-bands, the first segment almost all pale pollinose; hair black, pale yellowish on the first segment, sides of the second and third and on the basal four sternites; genitalia black and with rather thick black hair, the lower lamellae partly reddish.

FEMALE.—Thorax with narrower brown vittae and with only scattered, very short black hairs; scutellum pale brown on the disc; front tibiae mostly brown, the others reddish yellow with dark reddish apices, the tarsi dark reddish, becoming black apically; hair of the legs wholly short and not forming lateral fringes. Abdomen more olive-gray, the black dorsal spots much smaller and appearing brown in some views; genitalia shining black. Scutellum with extremely short black hairs.

Types.—Holotype, male, allotype, female, and paratype, female, Hartley, Southern Rhodesia, November, 1930; paratype, female, Hartley, December, 1930 (A. Cuthbertson). The allotype was preying on *Glossina morsitans*.

Superficially this species closely resembles *angusticornis* Ricardo, but the antennae are short. It also resembles *silaceus* Hermann in the color of the pollen of the thorax, but the abdomen is differently colored and the face has yellow hair. Miss Ricardo does not mention any hair on the face of *angusticornis*, but there are a few minute hairs near the mystax. Mr. Cuthbertson took a male and female of *angusticornis* at Hartley in January 1931.

***Stenopogon holoxanthus* Hermann**

HERMANN, 1907, Zeitschr. für Hymenopt., VII, p. 1.

Female, Nieuwoudtville, Cape Province, November 22 (T. D. A. Cockerell).

Miss Ricardo has suggested that this species may be the same as *dilutus* Walker but the palpi have yellow hair, whereas *dilutus* has the hair black. The hair on the specimen before me is paler than described by Hermann but, inasmuch as Hermann described the male, this may be a sexual difference. The apical abdominal segments are black only on the dorsum and on the narrow apices.

***Gonioscelis ventralis* Schiner**

SCHINER, 1867, Verh. zool.-bot. Ges. Wien, XVII, p. 363.

Two specimens of each sex, Salisbury, Southern Rhodesia, January 25, 1910, December 23, 1911, and January 1922.

ACNEPHALUM Macquart

The following key includes the Ethiopian species with the exception of the two described by Walker.

TABLE OF SPECIES

- 1.—Abdomen with white hair on the disk other than on the apices of the segments . . 2.
 Abdomen with white discal hair only on the apices of the segments 3.
- 2.—Median segments mostly white-haired, leaving a black dorsal spot.
 dorsale Macquart.
 Intermediate segments with transverse, arched patch of white hair in the middle.
 platygaster Loew.
- 3.—Wings pale brown on basal half, wholly hyaline on apical half . . . *cockerelli*, n. sp.
 Wings differently colored 4.
- 4.—Pale-haired fasciae rather narrowly interrupted on the intermediate segments;
 cross-veins strongly clouded; male unknown *andrenoides* Wiedemann.
 Pale fasciae short, not as long as the black space separating them; wings of
 male almost wholly brown *quadratum* Wiedemann.

Acnephalum cockerelli, new species

Pile mostly whitish, the wings rather pale yellowish-brown on a little more than the basal half. Length, 14 mm.

MALE.—Head white pollinose and pilose, a patch of brownish-red pile on either side of the face between the oral margin and eye and a small patch behind the upper corner of the eye; ocellar hairs with yellowish tinge. Proboscis largely reddish, the hair white; palpi black, white-haired. Antennae brown, the basal segments bearing white hair and pale yellow bristles; style white on apical half.

Thorax black, thickly clothed with white pile streaked with brownish yellow, apparently abraded posteriorly; mesopleura with some bristly yellow hairs posteriorly; mesonotum with some black hairs intermixed with the pale ones; humeri mostly brownish yellow-haired; bristles on sides of the mesonotum brownish yellow. Scutellum shining black, with a deep preapical depression, the apical margin with upturned white hair except in the middle, the disc with sparse white hair only on the sides, the white hair on the back of the mesonotum overhanging the scutellum and giving it the appearance of being white pilose.

Legs black; posterior four femora dark reddish except dorsally; middle tibiae reddish on the dorsal half, the posterior pair reddish with a posteroventral black stripe; tarsi becoming dull reddish apically; hair white, yellowish on the antero-dorsal surface of all the femora; bristles brownish yellow.

Wings light brownish on a little more than the basal half, hyaline apically, the cross-veins not clouded; fourth posterior cell broadly open; anterior branch of third vein with long appendage near the base. Squamae with yellow border and whitish fringe. Halteres reddish yellow.

Abdomen shining black, rather densely punctured, the sides and posterior border with dense, rather long white hair, that near the middle of the sides with yellowish tinge; apices of second to fourth segments with narrowly interrupted white pilose fasciae, the pale fasciae on the first and fifth segments very broadly interrupted; apical corners of the third and following segments reddish, the apical segment mostly

reddish, the preceding one with reddish posterior border. Venter with cinereous-yellow pollen and white hair. Genitalia small and mostly concealed by the dense pile

TYPE.—Male, Nieuwoudtville, Cape Province, November 20 (T. D. A. Cockerell).

***Acnephalum andrenoides* Wiedemann**

Dasypogon andrenoides WIEDEMANN, 1828, 'Ausser. Zweifl.,' I, p. 403.

One female, Nieuwoudtville, Cape Province, November 19 (M. Macgregor).

***Acnephalum quadratum* Wiedemann**

Dasypogon quadratum WIEDEMANN, 1828, 'Ausser. Zweifl.,' I, p. 404.

Male, Nieuwoudtville, Cape Province, November 19 (L. Ogilvie); male, top of Van Rhyn's Pass, Cape Province, November 19 (J. Ogilvie).

These have the wings brown with subhyaline indentations in the cells along the posterior border of the wings. The female described by Wiedemann had the wings wholly hyaline.

***Acnephalum platygaster* Loew**

LOEW, 1858 (1857), Öfvers. Kongl. Vet. Akad. Förhandl., XV, p. 338.

Female, foot of Van Rhyn's Pass, Cape Province, November 21 (Mrs. Cockerell).

SCYLATICUS Loew

The following key will serve to separate the known Ethiopian species.

TABLE OF SPECIES

- 1.—*Mystax* yellow.....*rufescens* Ricardo
Mystax white.....2.
- 2.—Wings hyaline, the cross-veins clouded...*varipennis* Ricardo.
Wings largely brownish, brownish gray or cinereous.....3.
- 3.—Wings brownish gray or cinereous and broadly lutescent anteriorly or basally..4.
Wings broadly brown in front, hyaline behind...*costalis* Wiedemann.
- 4.—Antennae black.....*zonatus* Loew.
Antennae reddish, the first segment blackish.....*pantherinus* Bigot.

***Scylaticus zonatus* Loew**

LOEW, 1858 (1857), Öfvers Kongl. Vet. Akad. Förhandl., XIV, p. 349.

Male, Calvinia, Cape Province, November 13 (T. D. A. Cockerell).

Agrees well with Loew's description but the femora are paler and the tarsi reddish. It may represent a different species.

***Scylaticus costalis* Wiedemann**

Dioctria costalis WIEDEMANN, 1819, Zool. Mag., I, p. 3.

Female, Salisbury, Southern Rhodesia, February 17, 1912.

***Ancylorrhynchus quadrimaculatus* Loew**

Xiphocerus quadrimaculatus LOEW, 1858 (1857), Öfvers. Kongl. Vet. Akad. Förhandl., XIV, p. 348; 1868, 'Dipt.-Fauna Sudafr.,' p. 83.

Female, Nieuwoudtville, Cape Province, November 20 (J. Ogilvie).

Agrees fairly well with Loew's description but the red of the sides of the mesonotum forms an entire stripe, the scutellum is reddish and the hair on the upper part of the occiput is tawny. The black palpi bear stout black hairs although some toward the apex are tawny.

***Ancylorrhynchus apicalis*, new species**

Colored almost as in *cruciger* Loew, but the fourth posterior cell is very broadly open. Length, 15 mm.

FEMALE.—Head black in ground color, the face reddish with a narrow, median black V extending downward from the base of the antennae. Front brownish-yellow pollinose except in the middle, the hair yellowish. Posterior orbits broadly ochreous pollinose except below, the pile tawny, paler at the vertex, a few black hairs behind the cheeks. Face clothed with reddish-yellow pollen and pile; cheeks shining black. Proboscis black, with black hair; palpi reddish, bearing coarse black hair. Antennae orange, the basal segment with similarly colored hair, the third almost as long as the head width, the style poorly differentiated.

Thorax black, the sides of the mesonotum very broadly orange-red, the black expanded in front of the suture to form a cruciate marking; pronotum reddish; scutellum reddish with the base narrowly deep black; hair black on the pleura, reddish yellow or yellowish on the dorsum; the hair in front of the halteres tawny.

Legs reddish yellow, the femora reddish; hair white, the fine bristles on the under surface of the anterior four femora black; coxae brownish-gray pollinose and with yellowish hair; anterior tarsi with black hair above, the others with black hair dorsally on only the apical one or two segments; bristles of the femora and tibiae reddish yellow.

Wings luteous, tinged with brown posteriorly, the apical fourth brown; fourth posterior cell very widely open. Squamae yellowish, with pale yellow fringe. Knob of halteres sulphur-yellow.

Abdomen dull orange, the first segment and narrow base and median vitta on the second dull black; bases of second to sixth segments with dull black lateral triangles which extend very narrowly or obscurely across the base of the segment. Venter apparently black, the sternites with pale apices (most of it has been eaten away) seventh segment shining reddish with the sides and base laterally shining black; ovipositor shining reddish. Hair tawny, pale on the venter.

TYPE.—Female, Matetsi, Southern Rhodesia, April 1933.

***Teratopus cyaneus* Fabricius**

Asilus cyaneus FABRICIUS, 1781, 'Spec. Insect.,' II, p. 465.

One male, Nieuwoudtville, Cape Province, November 22 (Alice Mackie).

In this specimen the occiput appears much less swollen than in the female figured by Loew, due to the larger eyes.

DAMALIS Fabricius

The following key will serve to distinguish this genus and the two separated from it by Hermann.

- 1.—Mesonotum with lateral bristles; mystax reaching almost to the antennae.
Lasiodamalis Hermann.
Mesonotum without lateral bristles. 2.
- 2.—Apex of the middle tibiae strongly produced. *Lophurodamalis* Hermann.
Middle tibiae not modified. *Damalis* Fabricius.

LOPHURODAMALIS Hermann

TABLE OF SPECIES

- 1.—Mystax black. 2.
Mystax yellowish. *speciosa* Loew.
- 2.—Tibiae reddish yellow, with black apices. 3.
Tibiae black on more than the apical half. *natalensis*, n. sp.
- 3.—Middle tarsi of male simple; wings pale brown except in front. *simplex*, n. sp.
Third segment of middle tarsi of male very strongly produced; wings rather dark brown. *hirtiventris* Macquart.

Lophurodamalis natalensis, new species

Related to *fervida* Walker but readily distinguished by the color of the legs. Length, 13 mm.

MALE.—Head black; face and front with thin brown pollen and black hair; occiput cinereous pollinose and with pale hair, the occipital cilia fine and black. Palpi black, the hair mostly sordid yellow but long and black apically. Antennae black, with black hair.

Thorax black in ground color, the hair yellowish on the pleura, tawny on the dorsum, the disc with black bristly hair. Pollen rather tawny, the disc bare and shining black but with an obscure pollinose stripe along the line of the dorsocentrals and with thin pollen above the humeri, the black extending to the anterior margin in the middle. Hair long on the mesonotum.

Legs shining black, the coxae cinereous pollinose; basal third of the tibiae and of the posterior femora reddish. Anterior four femora with long hair, the posterior pair with short, appressed hair and with black spines on the apical half below. Anterior tibiae with long soft hair on the posterior half, the middle pair clothed with coarse bristly black hair on the lower half, the posterior tibiae with appressed black hair. Middle tibiae strongly produced on the ventral apex, the protuberance bearing short, stout apical bristles; middle tarsi with the fourth segment bearing a stout, ventral, apical process, its length almost equal to the length of the segment, the third segment weakly produced.

Wings brown, somewhat paler behind. Squamae rather tawny, with reddish hair. Knob of halteres brown.

Abdomen reddish yellow, the apex and venter brownish; pile reddish, rather abundant and long, the genitalia with black hair.

TYPE.—Male, Durban, Natal.

Lophurodamalis simplex, new species

Apparently related to *Discocephala fervida* Walker, a species probably belonging to *Lophurodamalis*, but with paler wings and more extensively black legs. Length, 10 to 11.5 mm.

MALE.—Head black in ground color, the front and face with rich brownish-yellow pollen and black hair, the upwardly curved hairs of the face yellowish; occiput with cinereous pollen and dull yellowish pile. Palpi black, the hair practically all yellow. Antennae black, the third segment smaller than the second, the arista gently widened and colorless apically; basal segments with black bristles.

Thorax ochreous pollinose, the mesonotum decidedly darker on the disc, with three broad brown vittae, the middle one geminate anteriorly, the outer ones short and weakly interrupted at the suture. Hair yellow and rather long, black and coarser along the middle of the mesonotum on the anterior three-fourths. Scutellum luteous, with fine rich yellow hairs and a marginal row of fine, reddish-yellow bristles.

Legs reddish; coxae black, cinereous-yellow pollinose and pilose; trochanters mostly shining reddish; anterior four femora with black stripe anteriorly toward the lower side and with blackish tips, the posterior femora black on the apical half, moderately swollen and with appressed hair and several black spines below on the apical half; anterior four femora with long yellowish hair above and black hair below, the middle pair with black ventral bristles; tibiae, especially the posterior pair, with blackish apices, the hair and bristles black, short on the posterior pair; middle tibiae rather strongly produced apically; tarsi reddish, the tips of the segments blackish, the bristles long and fine, the anterior tarsi with long crinkly hair in addition to the bristles.

Wings light brownish, the costal border brown; anterior cross-vein situated near the apical fourth of the discal cell. Squamae with bright yellow fringe. Knob of halteres reddish.

Abdomen reddish, the apical three segments darkened on the disc, at least basally, thickly clothed with tawny pile, the broad middle line with short, appressed black hair except on the basal two segments; venter broadly black in the middle, thickly cinereous-yellow pollinose and reddish-yellowish pilose. Genitalia shining reddish with the appendages black apically.

FEMALE.—Agrees with the male but the hair and bristles on the legs are shorter and there are no fine, long hairs on the front tarsi; all the tergites with transverse black fasciae basally, the tawny abdominal pile shorter and subappressed. Genitalia reddish.

TYPE.—Holotype, male, allotype, female, and paratype, female, Vumba, Umtali District, Southern Rhodesia, March 3, 17, 19, 1931 (P. A. Sheppard).

DAMALIS Fabricius

The single species before me is very distinct from any thus far described.

TABLE OF SPECIES

- 1.—Wings dark brown on the basal two-thirds, the apex hyaline. *conspicua*, n. sp.
Wings differently colored. 2.
- 2.—Wings pale brown, rather reddish yellow along the costal border.

femoralis Ricardo.

- Wings much less extensively brown or wholly hyaline. 3.
 3.—Wings hyaline or nearly so. 4.
 Wings rather intensively brown basally and in front. *maxima* Hermann.
 4.—Hair of the face black. 5.
 Hair of the face yellow, the bristles black. *pollinaria* Hermann.
 5.—Legs reddish yellow. *hyali pennis* Macquart.
 Legs shining reddish-brown. *pollinosa* Ricardo.

***Damalis conspicua*, new species**

Black, the basal two-thirds of the wing dark brown; legs partly reddish yellow
 Length, 10 mm.

MALE.—Head with cinereous-white tomentum and without shining areas. Face and front with black hair, the mystax rather bristly; occiput with soft white hair, the beard white. Palpi reddish yellow, clothed with soft white hair. Antennae black, the third segment about as large as the second, the hair black; arista white on the apical third.

Thorax cinereous pollinose, the middle of the mesonotum with brownish pollen on the anterior three-fourths and a pair of narrow, bare vittae on the anterior two-thirds, the outer vittae represented by two bare spots on either side. Hair of the mesonotum black, but white on the posterior calli and on the sides in front of the suture. Pleura with soft white hair. Scutellum bare on the broad apex, bearing four marginal bristles, without hair except on the black margin. Posterior calli bearing two black bristles.

Legs black; coxae cinereous pollinose and white-haired; trochanters partly reddish yellow; anterior and middle femora broadly reddish yellow above, the posterior pair reddish on the posterodorsal half; hair whitish, black on the ventral surface. Anterior tibiae dull reddish on the upper surface of the basal half, the posterior four tibiae dull reddish-yellow on about the upper half; hair white, the bristles very fine and black, the posterior tibiae with black hair below. Tarsi black, the bases of the segments yellowish, the apical segments only narrowly pale basally, the basal segments broadly pale, the anterior tarsi, however, with only the narrow bases of the segments pale; hair black.

Wings brown on the basal two-thirds, the apex hyaline. Squamae with white fringe. Knob of halteres black.

Abdomen black, the bases of the segments rather broadly cinereous, the pollen expanding laterally so as to occupy the whole length of the segment, the first segment wholly pollinose, the second mostly so, the seventh with pollen only on the sides. Venter cinereous pollinose, each segment with a small bare spot. Hair black on the dorsum, whitish on the sides and venter. Genitalia black, the outer forceps mostly cinereous pollinose.

TYPE.—Male, Calvinia, Cape Province, November 14 (L. Ogilvie); received from Dr. T. D. A. Cockerell.

LOPHOPELTIS Engel

The key includes the African species which are sufficiently well described to be placed by means of the characters used.

TABLE OF SPECIES

1.—Mane extending the whole length of the mesonotum.	23.
Mane obsolete on the anterior half of the mesonotum.	23.
2.—Mane wholly white posteriorly.	3.
Mane black on whole length, sometimes bordered with short white hairs.	9.
3.—Abdomen with abundant appressed white hair and without black hair on the disc.	4.
Abdomen not wholly clothed with white hair.	5.
4.—Mystax wholly white; abdomen with white bristles.	<i>mohitor</i> Wiedemann
Mystax black and white.	22.
5.—Scutellum with pale bristles.	6.
Scutellum with black bristles.	7.
6.—Legs blackish.	<i>spiniiventris</i> Loew.
Tibiae and tarsi reddish.	<i>transvaalensis</i> Ricardo.
7.—Tibiae reddish, sometimes with black stripe.	8.
Tibiae black, the base reddish.	<i>albofasciatus</i> Ricardo.
8.—Front and middle tibiae with black stripe.	<i>leucotaenia</i> Bezzi.
Tibiae without black stripe.	<i>ustulatus</i> Loew.
9.—Abdomen clothed with appressed white hairs only.	20.
Abdomen not wholly white-haired.	10.
10.—Thorax with light ochre-yellow short hair.	<i>pulcher</i> Loew.
Thorax without such hair.	11.
11.—Hair of scutellum wholly black; tibiae reddish basally; genitalia short.	<i>nigricans</i> Ricardo.
Hair of scutellum partly white or yellowish.	12.
12.—Scutellum with pale bristles.	13.
Scutellum with black bristles.	14.
13.—Legs wholly black; mane not bordered with white; genitalia small.	<i>rapax</i> Ricardo.
Tibiae red basally; mane bordered with short white hairs; genitalia large.	<i>natalensis</i> Ricardo.
14.—Scutellum with two or four tufts of white hair or with yellow hair.	15.
Scutellum with white hair in the middle; hairy species with almost wholly black legs.	<i>hirsutus</i> Ricardo.
15.—Abdomen with black median vitta; scutellum with reddish-yellow and whitish hair.	<i>wroughtoni</i> Ricardo.
Abdomen sometimes with a row of triangular spots; hair of scutellum differently colored.	16.
16.—Scutellum with tufts of white hair.	17.
Scutellum with yellow hair.	<i>genitalis</i> Ricardo.
17.—Scutellum with discal tufts of white hair in addition to the lateral tufts.	<i>montanus</i> Ricardo.
Scutellum with only the lateral tufts of white hair, the disc usually with black bristly hair.	18.
18.—Disc of scutellum with numerous black hairs or bristles.	19.
Disc of scutellum with only one or two hairs and about four black bristles in a preapical row.	<i>arno</i> , n. sp.

- 19.—Mane bordered with short yellow hairs.....*similis* Ricardo.
 Mane not bordered with pale hairs.....*cuthbertsoni*, n. sp.
- 20.—Male genitalia long and tapering; bristles on the posterior four femora white;
 length 10 mm.....*parvus* Ricardo.
 Male genitalia shorter and but little tapering; bristles on the femora black;
 length, 13 to 15 mm.....21.
- 21.—Apex of upper forceps of male transverse and gently emarginate; seventh seg-
 ment of female broadly white-haired basally.....*angola*, n. sp.
 Apex of upper forceps of male gently convex apically; fourth segment of female
 almost all black-haired.....*incisuralis* Macquart.
- 22.—Beard yellowish; upper genital lamellae of male a little longer than the lower;
 tergum with white bristles.....*albovittatus* Schiner.
 Beard white; upper genital lamellae of male twice as long as the lower; tergum
 with black bristles.....*albion*, n. sp.
- 23.—Mane black and white or yellow.....24.
 Mane black; mystax white and black; scutellum with white hairs and bristles.
angustibarbis Loew.
- 24.—Mystax wholly yellow, the bristles at the sides of the mouth black.
setiventris Loew.
- Mystax with black hairs above or laterally.....25.
- 25.—Mane white posteriorly.....*albopilosus* Ricardo.
 Mane black and yellow, rather scanty.....*nigripes* Ricardo.

Lophopeltis cuthbertsoni, new species

Black, the extreme base of the tibiae and the halteres reddish; mane wholly black; scutellum white-haired on the sides. Length, 13 to 14 mm.

MALE.—Head whitish pollinose, the front thinly so; ocellar tubercle with thin brown pollen, the face shining beneath the mystax. Frontal hair black. Occiput with white pile, the occipital cilia black, numerous above; beard white. Mystax black, with numerous white bristly hairs in the middle except near the oral margin. Palpi with black hair. Third antennal segment as long as the basal two combined, the arista slightly shorter than the third segment; hair wholly black.

Thorax with whitish pollen, the vittae brownish. Mane moderately long, wholly black, with longer bristles except behind; hair of the mesonotum black, white on the humeri, posterior calli, prothorax and the pleura, and sometimes a few white hairs in front of the scutellum. Scutellum with black hair in the middle and white hair on the sides, the bristles black, arranged in two rows of four.

Legs black; coxae with thick white hair; femora with black hair, the posterior surface mostly white-haired, the posterior pair with an incomplete, narrow stripe of white hair in front; hair on the ventral surface long and fine; bristles black. Tibiae with white hair and black bristles, the long hair on the ventral surface mixed with black, the bristles rather fine. Tarsi brownish red, black-haired, the anterior pair mostly white-haired above, the middle pair with white hair on the upper surface of the basal segments.

Wings with brownish tinge; anterior cross-vein situated near the apical third of the discal cell. Squamae with white fringe. Halteres reddish yellow.

Abdomen with the sides and segmental apices clothed with cinereous-white pollen, the sixth and seventh segments with only a broad median vitta shining, the remaining segments appearing pale pollinose anteriorly when viewed from behind. Hair black on the dorsum, white on the sides, the white hair forming small triangles on the bases of the segments; bristles black, except the lateral one. Venter cinereous pollinose and with white hair and bristles. Genitalia small, the upper forceps slightly tapering, pointed below, the apex oblique and with a small triangle at the upper apical corner; lower forceps short; hair black, moderately dense on the lower surface of the upper forceps.

FEMALE.—Tarsi black and with scarcely any white hair above; tibiae with less long hair below; ovipositor shining black, slightly longer than the eighth segment.

TYPES.—Holotype, male, Salisbury, Southern Rhodesia, September 8, 1912; allotype, Salisbury, March 8, 1918. Paratypes, male, Salisbury, September 20, 1917, and male, September 1927, the latter collected by A. Cuthbertson.

Lophopeltis arno, new species

Black, the immediate base of the tibiae and the halteres reddish; mane wholly black; scutellum without hair on the disc. Length, 13 mm.

MALE.—Head white pollinose, the ocellar tubercle very thinly so, the face shining beneath the mystax. Hair of the front black, a few white hairs opposite the antennae; occiput white pilose, the occipital cilia black and white, the long curved bristles all black; beard white. Mystax black, with rather few white bristly hairs on the upper two-thirds. Palpi with black hair. Antennae black, with short white hair and black bristles; third segment as long as the basal two combined, the arista a little more than half as long as the third segment.

Thorax with cinereous white pollen, the disc of the mesonotum rather bronzed, the vittae indistinct. Mesonotum with black hair, the sides in front and behind, the prothorax and the pleura white-haired; mane wholly black, not extending on to the scutellum, rather sparse, the bristles black. Scutellum with a discal and marginal row of four bristles and with white hair on the sides, the disc bare.

Legs bronzed black, white-haired; coxae thinly cinereous pollinose; posterior femora with erect black hair beneath, the anterior four with a few black hairs apically; tibiae with long brown hair beneath; tarsi black-haired, the anterior pair mostly white-haired above, the middle tarsi with white hair on the basal segment; bristles black, white on the posterior surface of the middle tibiae and front tarsi and the anterior surface of the middle tarsi.

Wings cinereous hyaline; anterior cross-vein situated somewhat beyond the middle of the discal cell and almost transverse. Squamae and halteres reddish yellow, the former with white fringe.

Abdomen with the sides and segmental apices cinereous white pollinose; hair black on the dorsum but the white hair extends strongly inward as large basal triangles; seventh and eighth segments pollinose except on the broad middle line. Venter cinereous white pollinose and white haired. Bristles black. Genitalia white haired, the upper surface with appressed black hair; upper forceps strongly narrowed on the apical fourth, the tips with dense, short stout bristly hairs on the inner surface; lower forceps about one-third as long as the upper.

TYPE.—Male, Melsetter, Southern Rhodesia, October 1921.

***Lophopeltis angola*, new species**

Black, the immediate base of the tibiae and the halteres reddish yellow; mane black, edged by a white line. Length, 14 mm.

MALE.—Head whitish pollinose, the ocellar tubercle almost bare, the face shining beneath the mystax. Front with mostly white hair, the ocellar bristles black. Beard and occipital pile and bristles white, the long curved occipital cilia black, not numerous. Mystax mostly white, the bristles on the sides of the oral margin black. Palpi with black hairs on the apical half. Antennae with white hair and long black bristles; third segment about as long as the basal two combined; style three-fifths as long as the third segment.

Thorax whitish pollinose, the disc of the mesonotum appearing somewhat bronzed in some lights; hair mostly white, but broadly black on the disc in front of and behind the suture; mane strong, edged by a line of somewhat shorter white hairs. Scutellum with long white, not tufted hair, two black discal bristles and four marginals.

Legs black; coxae pale pollinose and white-haired. Hair white, the anterior four femora black-haired in front, the posterior pair with black hair on the ventral third; all the femora and tibiae with long black hairs below, although on the middle and posterior tibiae the long hairs are mostly white; tarsi wholly white-haired above; bristles black, white on the upper surface of the anterior four tarsi and on the posterior surface of the front tibiae.

Wings cinereous hyaline; anterior cross-vein situated somewhat before the apical third of the discal cell. Squamae and halteres reddish yellow, the former with white fringe.

Abdomen wholly clothed with white hair, the sides more thickly and evenly cinereous pollinose than the dorsum; venter cinereous pollinose; bristles almost all black. Genitalia thinly pollinose, short, upper forceps gently tapering and with a gently concave apex, the lower forceps slightly more than half as long as the upper and with thick white hair below.

FEMALE.—Legs with very little long hair below and it is mostly black; posterior and middle tarsi black-haired above except at the base. Thorax with rather ochreous pollen; abdomen with yellowish-cinereous pollen and a black-haired dorsal stripe that is broadly interrupted on the third to fifth segments, the base wholly white-haired; ovipositor one-sixth longer than the seventh segment, black-haired.

Types.—Holotype, male and allotype, female, Capelongo, Angola, July 25, 1925, and paratype, female, Pico Avezedo, Angola, July 23–27, 1925.

This species is very similar to the one I have identified as *incisuralis* Macquart but may be readily distinguished by the characters enumerated in the key.

***Lophopeltis albion*, new species**

Black, the immediate base of the tibiae and the halteres reddish yellow; mane black, edged with white, the posterior fourth wholly white. Length, 12.5 mm.

MALE.—Head whitish pollinose, the ocellar tubercle almost bare, the face shining beneath the mystax. Front with white hair, the ocellar bristles black; beard, lower occipital cilia and the occipital pile white, the upper occipital cilia and the long curved bristles black. Mystax white with black bristly hairs intermixed,

wholly black along the oral margin. Palpi with black hair. Antennae with short white hair above and black bristles below; third segment somewhat shorter than the basal two combined, the arista as long as the third segment.

Thorax with whitish pollen, the mesonotum lightly bronzed in some views, the hair white except broadly in front of and behind the suture on the disc. Mane black on the anterior three-fourths, edged with white, the posterior fourth white. Scutellum with thick white hair and bearing eight black bristles arranged in two rows, four on the disc and four on the margin.

Legs black; coxae thinly pale pollinose and white-haired; femora with appressed black hair, the posterior surface of the front pair and the upper surface of the posterior four white-haired, the lower surface with sparse, long black hairs; tibiae with white hair, the hair long below, black beneath the anterior pair. Tarsi white-haired above, the anterior four with white bristles dorsally, the anterior tibiae with a row of white bristles on the apical half of the posterior surface; bristles black.

Wings cinereous hyaline; anterior cross-vein situated moderately beyond the middle of the discal cell. Squamae and halteres reddish yellow, the former with white fringe.

Abdomen wholly white-haired, rather thinly white pollinose, the bristles of the dorsum black, those of the venter mostly white. Genitalia short, becoming reddish apically; upper forceps gently tapering, obtusely rounded apically, the lower forceps about half as long as the upper; hair white.

TYPE.—Male, Capelongo, Angola, July 25, 1925.

CYRTIDAE

Psilodera fasciata Wiedemann

Cyrtus fasciatus WIEDEMANN, 1819, Zool. Mag., I, part 3, p. 14.

Male, Port Elizabeth, October 29 (J. Ogilvie).

Diopsidae

Diopsis cruciata, new species

Related to *apicalis* Dalmann but at once distinguished by the presence on the mesonotum of a very broad longitudinal and transverse band of cinereous pollen. Length, 7 to 8 mm. Width of head: male, 9 to 11 mm.; female, 7 to 9.5 mm.

MALE.—Head reddish, with a brownish stripe along the suture separating the face and front. Ocellar triangle and ends of the eye-stalks black, the latter thinly cinereous pollinose. Front with a gentle swelling in front of the ocelli margined by a slight, subcordate, depression; in front with several low ridges extending at right angles from the suture. Facial spines long and porrect; sides of face almost straight, gently converging below. Eye-stalks with a short, rather fine median bristle and with a stronger one behind the eyes. Antennae reddish, the arista brown.

Thorax shining black in ground color; mesonotum with a very broad median vitta, a slightly narrower transverse fascia immediately in front of the suture and the posterior margin cinereous pollinose; pleura cinereous pollinose with a very large, oval, shining area in the middle. Prothorax shining. Pollen of the scutellum becoming brown apically; scutellar spines reddish, their narrow base and very broad apices blackish. Hair of thorax very fine and pale yellowish.

Legs pale orange, the anterior tibiae and tarsi, basal and apical third of the posterior tibiae, and the apices of the middle and posterior tarsi, brownish. Spur of posterior femora very short.

Wings cinereous hyaline, with a large, subcircular, apical brown spot and broad, pale brownish band extending across the middle and produced, in the apical cell, to inside the anterior cross-vein. Halteres very pale yellowish.

Abdomen reddish, the base broadly and the apices of the intermediate segments brownish, the second segment sometimes darkened in the middle.

FEMALE.—Agrees with the male except that the eye-stalks are shorter and the abdomen slightly broader.

Types.—Holotype, male, Tshibinda, August 26, 1931 (Alice Mackie). Allotype, female, Chirinda Forest, Southern Rhodesia, November, 1930 (A. Cuthbertson). Paratypes: three males, Umtali, September, 1927, and female, Chirinda Forest, Southern Rhodesia, November 1930 (A. Cuthbertson); female, "Uganda"; female, Kivu-Lulenga, November 13, 1925 (H. Schouteden).

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FOSSIL BIRDS FROM MONGOLIA AND CHINA¹

BY ALEXANDER WETMORE²

During the Central Asiatic Expeditions of the American Museum of Natural History under Dr. Roy Chapman Andrews, there were obtained several collections of remains of fossil birds that, through the interest of Dr. Walter Granger, have been placed in my hands for study with results of more than usual value. Investigation of this material though seemingly difficult has proved relatively simple when definitely undertaken, particularly because of the little that is known of the fossil avifauna of the area concerned. The rich osteological collections of the U. S. National Museum contain good series of skeletons of eastern palaearctic birds without which these studies would have been impossible. The final results of these investigations add materially to knowledge of the ancient bird life of the area concerned.

The material secured may be divided naturally into two groups, of which the first includes numerous remains from the Eocene with fragmentary material from Oligocene and Miocene deposits. These specimens are all from Inner Mongolia and are made up of heavily fossilized bones that in many cases are very well preserved in spite of their antiquity.

Little has been published on the Tertiary bird life of eastern Asia. Teilhard de Chardin³ figures without name the lower part of a tibiotarsus of a bird from Tertiary deposits near Saint-Jacques (San-tao-ho) on the plateau of Ordos that may possibly be a form of the genus of crane described in the pages that follow. As *Baluchitherium grangeri* is listed from these same deposits, the beds are supposed to be of Oligocene age. From Oligocene deposits in the red beds of Chiton-gol, Inner Mongolia, the same author (p. 42) mentions fragments of ostrich eggs. Other accounts of fossil birds from the Tertiary horizons of this broad area so far as they have come to my attention refer principally to eggs and bones of the Struthionidae⁴ none of which were included in the present collections.

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 123

²Assistant Secretary, Smithsonian Institution.

³1926, Ann. Pal., XV, p. 31, Pl. III, fig. 9.

⁴See Lowe, P. R. 1931, Pal. Sin., Ser. C, VI, fasc. 4, pp. 5-10.

The second group of specimens includes bones obtained from bone pits, known for many years through the operations of Chinese who have mined them commercially, at Yen-Ching-Kou, near Wanh sien, in the province of Szechwan, China. This material includes specimens of Pleistocene age with some that are of uncertain antiquity, though it is probable that all come from Ice Age deposits.

Records of bird remains from Pleistocene deposits in the general area under discussion are somewhat more numerous than those from the Tertiary, though here information is as yet scant, and few species have been definitely reported.¹ The tragopan and the Lady Amherst's pheasant recorded beyond, from Yen-Ching-Kou, seem to be the first reports of these species in fossil deposits. The beds concerned should yield much additional information if further collections can be obtained from them.

The two sets of collections are treated separately in the account that follows, to permit a consistent systematic arrangement and a logical presentation of the species concerned.

Drawings illustrating this report have been made by Sydney Prentice.

I. COLLECTIONS FROM INNER MONGOLIA

Order **FALCONIFORMES**

In 1928 in the Upper Eocene of the Irдин Manha (Ulan Shireh) formation at Chimney Butte, Shara Murun region, Inner Mongolia, with other bird bones, there was obtained a left coracoid (Amer. Mus. 2941) of a large hawk. (Fig. 1.) In general form and proportions this specimen resembles species of the subfamily Buteoninae in the family Accipitridae so far as its characters may be ascertained. The bone has been somewhat crushed and distorted, so that, while it appears in fair condition, on careful examination there is doubt as to a good proportion of its characters. This uncertainty and the fact that the coracoid at its best ordinarily shows few differences in related species other than that of size, have made this fossil of such doubtful status that it has been deemed best not to name it except to indicate that it belongs in the Falconiformes.

As one of its principal peculiarities the scapular facet is more deeply impressed than in any modern species examined, the depression being nearly circular, with its boundary complete and not broken. The internal distal angle seems to have had a considerable projection. The bone was pneumatic and has a well marked foramen on the inner side of the shaft.

¹See Bate, Dorothea M. A., 1931, *Pal. Sin.*, Ser. C, VI, fasc. 4, pp. 41-47.

It is believed to be representative of a family group ancestral to the Accipitridae, an assumption that only further material can verify.

(Order **GRUIFORMES**

Superfamily **GRUOIDEA**

Family **EOGRUIDAE**, nov.

Related to *Gruidae* but with lateral trochlea of metatarsus reduced and simplified in form, the leg and foot being modified for running; legs long and slender; other characters indicated in the description of genus and species following.

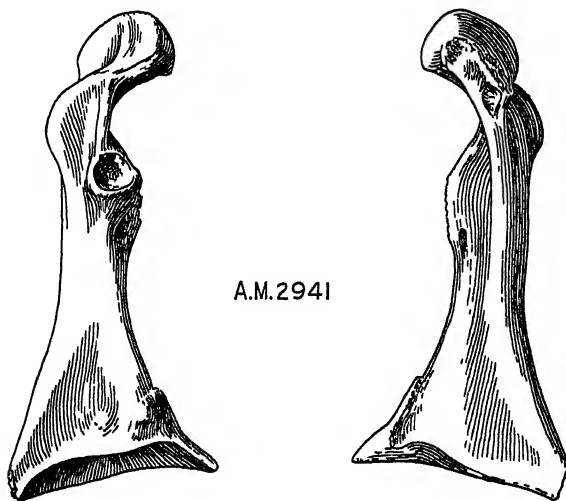


Fig. 1. Coracoid of a hawk from the Irдин Manha beds, Upper Eocene, of Mongolia. Amer. Mus. No. 2941. Natural size.

Eogrus aeola, gen. et sp. nov.

TYPE:—Amer. Mus. 2936 (Field No. 636), a right metatarsus nearly complete. From the Irдин Manha (Ulan Shireh) formation, Upper Eocene, of Chimney Butte, Shara Murun region, Inner Mongolia. Collected in 1928 by Dr. Walter Granger.

CHARACTERS:—In proportions of leg generally similar to *Grus canadensis* (Linnaeus)¹ but differing decidedly in contour and form; metatarsus with middle trochlea elongated; inner and outer trochlea reduced, with wing of inner trochlea little developed; distal foramen elevated in relative position on shaft, relatively small in size; a ridge extending up posterior surface of shaft to merge with talon; head of bone more gracefully formed; tibiotarsus having the intercondylar fossa much

¹1758, *Ardea canadensis* Linnaeus, Syst. Nat., ed. 10, I, p. 141.

narrower, with walls rising more abruptly; supratendinal bridge decidedly narrow; internal ligamental prominence restricted, less elevated; groove for peroneus profundus less developed. (Figs. 2 5.)

DESCRIPTION OF TYPE.—Head (Fig. 2) abruptly expanded on shaft, the cotyla of the proximal articular surface distinctly cupped, with sharp-edged margins, the external one lower than the internal, the two separated by a high triangular intercotylar protuberance; talon projecting posteriorly as an irregular block, the inner face plane, forming a right

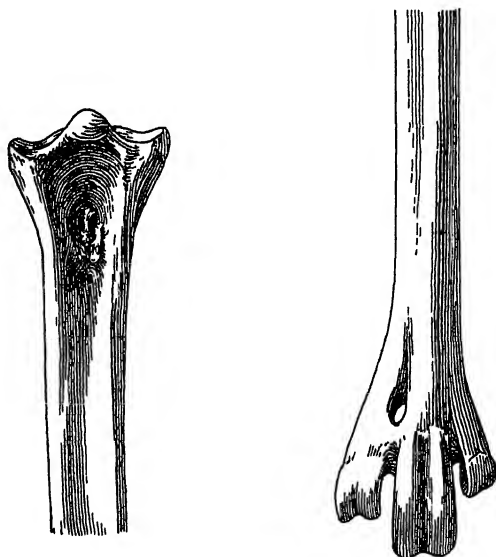


Fig. 2. *Eoagrus aeola*, gen. et. sp. nov. Anterior view of proximal (Am. Mus. No. 2936, type) and distal (Am. Mus. No. 2937) portions of metatarsus. Natural size.

angle with the cross axis of the head, outer face irregularly rounded; perforated by a large foramen and merging gradually distally with the shaft; a pronounced excavation below head on anterior face in which there are the usual two foramina; tibialis anticus tubercle and proximal ligamental attachment at same level; shaft slender, shallowly concave on anterior face, the channel less marked below the middle but persisting faintly until it merges with the depression in which the distal foramen is located; outer face of shaft forming a right angle with the anterior surface, slightly concave for proximal half; posterior face raised in a ridge that is slightly grooved for two-thirds of its length below the point

where the talon merges with the shaft; inner face of shaft rounded toward the ridge mentioned; distal end of shaft broadened and flattened transversely with a well marked distal foramen; first toe apparently absent; inner trochlea, relatively reduced in size, attached to the shaft by a narrow base, flattened from side to side, with the outer and inner faces somewhat excavated; outer margin slightly produced posteriorly, and posterior face slightly grooved; projecting distally for slightly more than one third of the length of the middle trochlea; middle trochlea relatively large and heavy, compressed laterally but thickened posteriorly: internal and external faces considerably excavated; a heavily marked groove around articular surface; trochlea somewhat narrowed and cut away on proximal posterior portion; external trochlea (distorted from its proper position in the type by pressure) relatively reduced in size though somewhat larger than the internal, reaching slightly beyond the middle of the central trochlea, and extended somewhat posteriorly; narrow and compressed with the inner face excavated; external margin slightly produced, with a slightly indicated groove around articular surface. Bone heavily fossilized, very pale brownish white in color.

MEASUREMENTS.—Type, total length 221 mm.; transverse breadth of head 21.7 mm.; least transverse diameter of shaft 8.5 mm.; transverse diameter through trochlea (approximate) 20.2 mm.; transverse diameter of middle trochlea 8.8 mm.; antero-posterior diameter of middle trochlea 12.5 mm.; transverse diameter of inner trochlea 4.7 mm.; transverse breadth of outer trochlea 6.2 mm.

REMARKS.—The present species is far more abundantly represented than is usual with fossil birds, though with one exception all of the material identified comes from the tibiotarsus or metatarsus.

From the type locality there were obtained six metatarsi in addition to the type, three of these being quite complete. One of these (Amer. Mus. 2937) has been used in illustrating the distal end of the metatarsus (Figs. 2 and 3), as the type has the external trochlea somewhat distorted.

These specimens are generally similar in conformation but vary somewhat in dimension as the following measurements will indicate: total length 235, 244 mm.; transverse diameter of head 22.7, 24.6 mm.; least transverse diameter of shaft 8.2, 8.6, 9.2, 9.5 mm.; transverse diameter through trochlea 20.7, 21.6, 22.1, 24.2, 24.2 mm.; transverse diameter of middle trochlea 8.6, 8.7, 9.0, 9.7 mm.; transverse diameter of

inner trochlea 4.9, 5.0, 5.3, 5.4 mm.; transverse diameter of outer trochlea 5.9, 6.0, 6.3, 6.4 mm.

In the same general locality as the type (i.e. Chimney Butte, Shara Murun region) there were obtained eight more or less complete tibiotarsi that are identified as *Eogrus aeola*. One of these is so badly crushed as to be barely recognizable, while the others have the distal portion complete with the head and upper end of the shaft broken and destroyed.

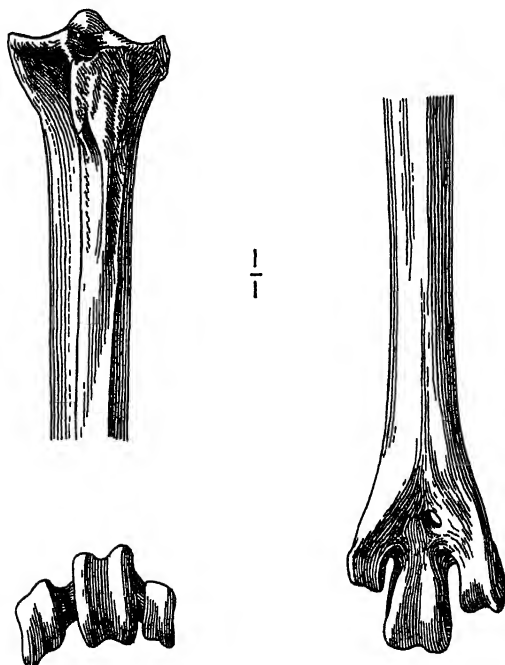
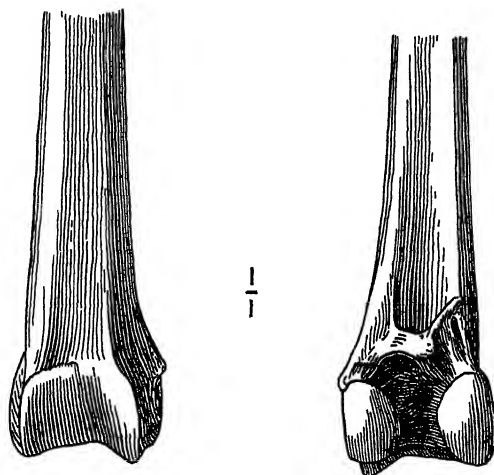


Fig. 3. *Eogrus aeola*, gen. et sp. nov. Posterior view of proximal portion (Am. Mus. No. 2936, type) and posterior and end views of distal portion (Am. Mus. No. 2937) of metatarsus. Natural size.

One is merely a fragment of the lower end. The characters of the lower part of the bone (drawn from No. 2939) are shown in the accompanying figures (Figs. 4, 5). No attempt has been made to restore the head from the fragmentary material available.

In general these tibiotarsi while strong are slender and elongated. Following is a description taken from specimen No. 2939: outer face of external condyle with anterior and posterior margins rounded, much flattened distally, projecting equally to the front and back of the median

line; external margin slightly raised to bound the faintly depressed central area; internal condyle with anterior portion flattened and compressed, projecting strongly forward; posterior section much wider with a sharp margin; lower edge flattened and slightly indented; a faintly indicated tubercle at level of anterior margin of shaft; rotular channel in



A.M.2939

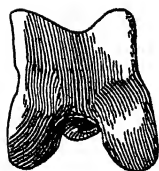


Fig. 4. *Eogrus aeola*, gen. et sp. nov., Amer. Mus. No. 2939. Anterior, posterior and distal views of tibio-tarsus. Natural size.

front relatively narrow and deep, marked by abrupt walls on either side which form right angles with the bottom; articular surface a broad, shallow groove, with distal surface irregularly impressed on either side by slight concavities; tendinal bridge relatively narrow, with a strong, raised tubercle external to it; shaft flattened in front and rounded behind.

Two other specimens show strongly developed crests and a heavy head but are so crushed that details are not certain. The peroneal ridge is well marked.

Following are pertinent measurements from these tibiotarsi: approximate length 260, 265 mm.; least transverse diameter of shaft 10.3, 10.5, 10.6, 10.6 mm.; transverse diameter through trochlea 19.1, 20.0, 20.1, 20.2, 20.7 mm.; antero-posterior diameter of outer condyle 19.1, 20.0, 20.1, 20.2, 20.5, 20.7 mm.; of inner condyle 19.7, 20.4, 20.9, 21.4 mm.

The distal ends of three additional tibiotarsi (Cat. No. 6600) collected in 1923 are labeled as from Irдин Manha beds without further

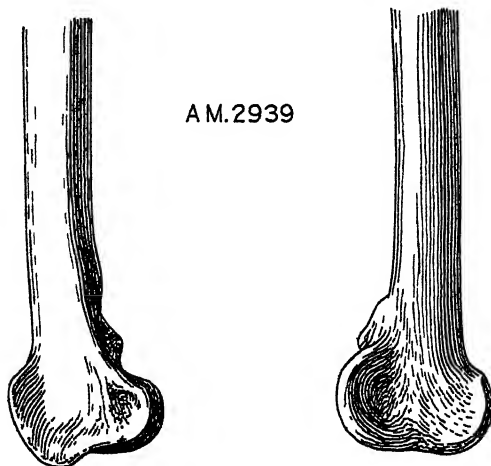


Fig. 5. *Eogrus aeola*, gen. et sp. nov., Amer. Mus. No. 2939. Lateral views of tibio-tarsus. Natural size.

locality. These specimens are well preserved and differ from those from Chimney Butte in being slaty in color instead of pale brownish white. They are strong and are heavily sculptured, showing the characters of the species fully. They measure as follows: transverse diameter through trochlea 18.9, 19.4, 21.5 mm.; antero-posterior diameter of outer condyle 18.6, 19.6, 20.0 mm.; of inner condyle 19.5, 20.0, 20.9 mm. They include extremes of dimension for this species.

Another fragment of the lower end of the tibiotarsus (Amer. Mus. 2947) was collected on July 14, 1930, in Irдин Manha beds five miles north of Arshanto Obo. This specimen, lacking the anterior portion of the inner condyle, seems identical with those listed above.

A small series of additional bones was obtained at various times in Irдин Manha deposits south and southwest of Iren Dabasu. Near Camp Margetts, 25 miles southwest of Iren Dabasu, there was obtained in 1930 the shaft of a metatarsus (Amer. Mus. 2948), much weathered, that offers no characters of note. A further lot (Amer. Mus. 2946) obtained at this same point in 1930 includes a complete metatarsus, the distal end of another, the lower end of a tibiotarsus and a first phalanx from the second digit of the wing. The complete metatarsus probably comes from an immature individual, since, though it is fully formed, the shaft appears slightly porous as is usual in young specimens. The bone has attained its full size in spite of its apparent immaturity, and is peculiar for its small dimensions, as the following measurements indicate: total length 21.3 mm.; transverse diameter of head 20.0 mm.; smallest transverse diameter of shaft 7.3 mm.; transverse diameter through trochlea 19.4 mm.; transverse diameter of middle trochlea 7.7 mm.; of inner trochlea 4.7 mm.; of outer trochlea 5.4 mm. The metatarsal fragment is larger. The section of tibiotarsus has no peculiarities of form but agrees with the complete metatarsus in small dimension. Measurements are as follows: least transverse diameter of shaft 10.0 mm.; transverse diameter through trochlea 17.9 mm.

Identification of the phalanx of the second digit of the wing as from *Eogrus aeola* is to some extent tentative since this is the only part from the wing that has been discovered. In general form it is suggestive of modern cranes but is somewhat smaller and appears slighter and weaker as though it came from a wing used only moderately. It has been somewhat distorted by pressure. It seems to indicate that *Eogrus* was a bird of only moderate powers of flight at best, as would be expected from the coursing habit shown in the structure of the lower limb.

Additional fragments (No. 2945) from Irдин Manha beds 25 miles southwest of Iren Dabasu, obtained in 1930, include fragments from the distal ends of a metatarsus and a tibiotarsus. The former agrees with the complete specimen (No. 2946) just described in small size. Three fragmentary bits of the lower ends of metatarsi collected in 1923, 23 miles south of Iren Dabasu in Irдин Manha beds, are too broken to give any additional information. They are darker than other specimens, being decidedly slaty in color.

With this understanding of the characters found in the material at hand, it will be of interest to consider the possible relationships of the species concerned.

Eogrus aeola, while sufficiently crane-like in the general sum of its diagnosis to be included in the Superfamily Gruoidea of the Suborder Grues, offers characters that give interesting suggestion of relationship to birds in two other of the suborders included in our present classification under the Gruiformes.

The modern *Cariama cristata* is obviously a bird of somewhat similar habit of life, and is suggestive in form of the fossil species because of its long and slender legs. Compared with *Cariama*, the metatarsus in *Eogrus aeola* has a similar conformation except that the middle trochlea in the fossil is relatively more slender and elongated. In addition, the outer trochlea is more elevated on the shaft and is relatively smaller, the sulci separating the trochlea are much deeper, and the groove on the posterior face of the shaft is much less evident. The talon in *Eogrus* is of entirely different form, being narrowed and elongated, more or less triangular in outline (being thus decidedly crane-like) instead of rectangular and like a block. The tibiotarsus of *Eogrus* has the general form of the condyles and of the anterior intercondylar fossa like those of *Cariama*. The supratendinal bridge and the tubercles for tendinal attachment on the shaft external to this bridge are, however, quite different, the bridge being narrowed, and the tubercles elevated, the latter resembling what is found in modern cranes and limpkins.

There is also found in *Eogrus* a definite indication of similarity to the bustards that is even more interesting. Comparison is made with the far eastern form of the common bustard, *Otis tarda dybowskii*. The metatarsus in *Eogrus* has the trochlea relatively more slender, the intertrochlear sulci much deeper, and the distal foramen more elevated. The talon is somewhat similar but in the fossil is reduced and elongated. Greater similarity is found in the tibiotarsus. The form of the condyles in *Eogrus* is closely similar, but the anterior condylar fossa is much deeper. The breadth and form of the supratendinal bridge also are quite similar, but in the fossil the tubercles external to the supratendinal bridge are much more developed and the internal ligamental prominence is less evident.

There are evident in *Eogrus*, therefore, characters that point toward relationship with the suborders Cariamae and Otides, connecting these two more certainly and definitely with the Grues and thus bringing into somewhat closer union three of the divergent elements at present placed in the order Gruiformes. The characters looking toward the bustards are especially interesting and valuable, as they serve to allocate a little more certainly this otherwise somewhat isolated group.

With the other suborders placed in the Gruiformes, *Eogrus* shows no closer resemblances than do other families in the superfamily Gruoidea.

With regard to the families closely related to the Gruidae, relationship with *Ecgrus* is clearly indicated. In the case of *Aramus* of the family Aramidae, resemblances and differences are so close to those already recorded for *Grus* that there is no need to detail them a second time.

In *Psophia leucoptera*, of the family Psophiidae, the upper end of the metatarsus is like that of *Eogrus* but has the talon projecting posteriorly to a greater degree, not sloping downward gradually to merge with the shaft as in the fossil. The form of the trochlea at the distal end of the bone in *Psophia* is quite different, being more like the condition found in *Cariama*. The lower end of the tibiotarsus in *Psophia* is suggestive of that of *Grus*, except that the tendinal tubercles are less developed. It offers differences from *Eogrus* like those found in *Grus*.

The Rallidae (Superfamily Ralloidea of the Suborder Grues) offer more trenchant differences, as indicated by a comparison with *Rallus longirostris*. In the tibiotarsus in *Eogrus*, the internal condyle is somewhat broader, viewed from the distal end, and the external condyle from the side is more flattened. The narrower internal condyle in *Rallus* throws the anterior intercondylar sulcus to the inner side instead of slightly toward the outer side as in *Eogrus*. The supratendinal bridge in *Rallus* is much wider, and the tubercles for tendinal attachment are only slightly developed. The metatarsus in *Rallus* in its general form resembles that of *Grus*, and so offers like differences when compared with *Eogrus*.

After due consideration of the sum of the characters of the lower limb in *Eogrus aeola*, it appears that it was a long-legged form, like the cranes and cariamas, that was specialized for running, in this exceeding the living cariamas of South America. That it was a species of highly developed coursing habit is indicated especially by the reduction in size of the lateral trochlea of the metatarsus, the difference being especially noticeable when comparison is made with *Grus* and *Aramus*. The middle trochlea, on the other hand, is strong and robust, being relatively larger than in the modern cranes. It is of interest to note that the size and position of the trochlea relative to one another are very similar to what is seen in the living rheas (far removed in relationship) which are birds that are strongly developed for running, though details of form are quite different. This similarity (due to convergence in form and not to relationship) is corroborative of the statement that *Eogrus* was highly specialized for running. The assumption is warranted that *Eogrus* was a form with weakened powers of flight.

After consideration of other fossil gruids, the only one that seems to offer any similarity is *Palaeogrus princeps* Portis, described from the lower end of a tibiotarsus from the Middle Eocene of Monte Zuello in Italy. The published figure indicates that the general outline of the condyles and of the anterior intercondylar sulcus was quite similar to that of *Eogrus*. The form of the anterior face of the bone, however, appears so entirely different in the position of the tendinal attachments that the two do not seem allied.¹

***Eogrus* sp.**

In collections made in 1922 in the Lower Oligocene of the Ardyn Obo beds, near Ardyn Obo, Outer Mongolia, there was obtained a fragmentary bit of the lower end of a left metatarsus referable to this genus. The lateral trochlea are broken away, and the margins of the middle trochlea and of the broken end of the shaft are more or less water-worn. In size and in characters, so far as these have been preserved, the specimen agrees with *Eogrus aeola* of the Upper Eocene, being evidently closely allied to that form, if indeed it is not identical with it. The latter supposition appears quite probable, but definite assertion to that effect may not be made, due to the fragmentary condition of the specimen.

The bone is important in its indication of the type of bird in question in Oligocene deposits.

***Eogrus* sp.**

In Tung Gur beds attributed to the Upper Miocene 40 miles south-east of Iren Dabasu, Inner Mongolia, in 1930 the lower end of a tibiotarsus (Amer. Mus. 2949) was collected that is referred without hesitation to the present genus. The bone is well preserved and shows fully the characters of the genus, being in conformation so similar to *Eogrus aeola* that no definite points of difference may be seen. In size it is small, being below the average of *E. aeola* and very slightly less than the smaller individuals of that form. It seems certain that it must represent another closely related form, but it is preferable to await description until more complete material is at hand.

The specimen has the following measurements: least transverse diameter of shaft 9.7 mm.; transverse diameter through trochlea 18.7 mm.; antero-posterior diameter of outer condyle 17.8 mm.; of inner condyle 17.7 mm.

¹1933, Lambrecht, Handb. Palaeorn., pp. 318-520.

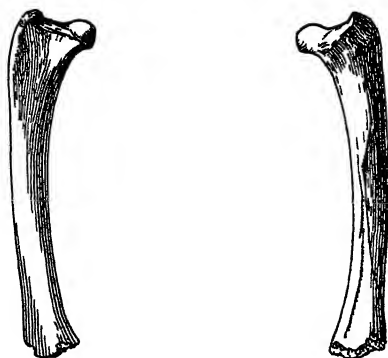
The genus *Eogrus* thus has an indicated range in time from the Upper Eocene to the Upper Miocene. It would appear, therefore, to have been a strongly dominant type of bird for a long period.

Superfamily **RALLOIDEA**

Family **RALLIDAE**

***Telecrex grangeri*, gen. et sp. nov.**

TYPE:—Amer. Mus 2942, a right femur with distal end missing. From the Irdin Manha (Ulan Shireh) formation, Upper Eocene, of Chimney Butte, Shara Murun region, Inner Mongolia. Collected in 1928 by Walter Granger.



AM 2942 Type

Fig. 6. *Telecrex grangeri*, gen. et sp. nov. Type, Amer. Mus No. 2942. Anterior, posterior and end views of femur. Natural size.

CHARACTER:—Femur differing from that of all modern rails examined in having the head compressed and flattened; trochanter reduced, with the iliac facet elongated and narrowed; distal section of shaft considerably flattened (Fig 6)

DESCRIPTION OF TYPE.—Head hemispherical, somewhat flattened on anterior side, with depression for ligamentum teres relatively slight and free margin decidedly under-cut; iliac facet elongated and narrowed, the lower, inner point where the articular surface is widest, coming opposite base of neck from where the lower margin slopes abruptly into the neck and more gradually toward the trochanter, giving a narrowed

compressed outline; trochanter partly broken away; neck only slightly smaller than head; trochanteric ridge well developed (somewhat broken); obturator ridge moderately strong; two linea aspera on lower surface of shaft, beginning below head at opposite sides, converging a short distance above middle of shaft, where they nearly touch, and then diverging gradually as they proceed backward; a nutrient foramen located between the two at the point where they nearly touch; shaft relatively slender, strongly curved, having the degree of flexure usual in modern rails, much flattened toward ends, less so in center; posterior end of bone missing. Color ivory white, strongly fossilized.

MEASUREMENTS.—Transverse breadth through head 11.9 mm., transverse breadth of shaft at center 4.7 mm.

REMARKS.—The specimen on which this species is based, while fragmentary, is so distinctly ralline and at the same time so different from the large series of modern rails available that I have had no hesitation in describing it. Its principal peculiarity lies in the compressed, narrowed outline of the anterior end, which is unlike anything I have found in modern species. The curvature of the shaft, particularly the distinct downward flexure at a point past the middle toward the distal end, is similar to that found in many living rails, particularly of the subfamily Rallinae.

Apparently *Telecrex* had the habits of such modern rails as those of the genera *Rallus*, *Aramides*, and others associated with them. After due consideration of its peculiarities, it seems proper to place it in a distinct subfamily, the **Telecrecinae**, in the Rallidae. It may be considered as ancestral to the modern Rallinae, and connected more remotely with the swimming forms. It does not seem to have close relationship with other fossil rails that have been described so far as may be ascertained.

The species is named in honor of Dr. Walter Granger of The American Museum of Natural History, under whose direction the avian fossils described in the present paper were mainly assembled.

II. COLLECTIONS FROM CHINA

Order **FALCONIFORMES**Superfamily **FALCONOIDEA**Family **ACCIPITRIDAE****Buteo hemilasius** Temminck and Schlegel

Buteo hemilasius TEMMINCK AND SCHLEGEL, Fauna Jap., Aves, 1844, p. 16, Pl. VII (Japan).

At Yen-Ching-Kou, Wanhsien, Szechwan, in early Pleistocene deposits in pits 31 and 116, Granger obtained a metacarpus, the distal end of a tibiotarsus and part of an ulna (Nos. 2953-2954) that are identified as the present species. The specimens are strong and robust, being much larger than *Buteo buteo*. The species is found in this region to-day but has not been recorded previously from the Pleistocene.

Order **GALLIFORMES**Suborder **GALLI**Superfamily **PHASIANOIDEA**Family **PHASIANIDAE****Tragopan temminckii** (Gray)

Satyra temminckii J. E. GRAY, Ill. Ind. Zool., I, 1830-32, pl. 50 (China).

A right metatarsus (No. 6340) was obtained by Granger in the pits at Yen-Ching-Kou, Wanhsien, Province of Szechwan, during the work of 1921-1922. The age is indicated by Granger as Pleistocene. While having the slender form of *Phasianus*, this differs in greater elevation of the spur core, the distance from the point of the core to the lower margin of the distal trochlea measuring 32.5 mm. In a male *Phasianus colchicus*, this distance is 18.8 mm.

Crossoptilon sp.

A left femur (No. 6329) was secured by Granger during work in 1921-1922 in the pits at Yen-Ching-Kou, Wanhsien, Szechwan, with other pheasant bones. The age is indicated by Granger as Pleistocene. The bone measures 98 mm. in length.

The eared pheasants are found to-day at high altitudes in the mountains.

Phasianus sp.

Collections made by Granger in 1921-1922 from the pits at Yen-Ching-Kou, Wanhsien, Szechwan, include two humeri, a tibiotarsus and a coracoid (Nos. 6327-6328) from pheasants of this genus. The material

is of Pleistocene age. Other collections in the same vicinity during the winters of 1921-1922, 1922-1923, and 1925-1926, in part from pits Nos. 31 and 116 (Nos. 2951-2952) in early Pleistocene deposits, include four humeri, a tibiotarsus lacking the head, and a metatarsus. *Phasianus colchicus* is a common bird in this region at the present time, and it is apparently a bird of this type that is represented in the fossil material.

***Chrysolophus amherstiae* (Leadbeater)**

Phasianus Amherstiae LEADBEATER, Trans. Linn. Soc. London, XVI, 1828, p. 129, Pl. xv (mountains of Cochin China).

In early Pleistocene deposits in pits 31 and 116 at Yen-Ching-Kou, Wanh sien, Szechwan, Granger obtained two partial femora (No. 2955) and a tibiotarsus (No. 2956) that agree exactly in size and form with this pheasant, found commonly to-day in this part of China. It has not been recorded previously from the Pleistocene.

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SOME AMERICAN SPIDERS OF THE FAMILY HAHNIIDAE

By W. J. GERTSCH

The spiders of the family Hahniidae, formerly regarded as constituting a subfamily of the Agelenidae, are sharply distinguished from all others by the singular arrangement of the spinnerets. The conventional three pairs are present, but they are placed in a transverse row, their bases being in nearly a straight line. The one-jointed middle pair is invariably shorter than the others, which are two-jointed. The outer or lateral pair, corresponding to the posterior spinnerets of other spiders, is usually longer than the second or anterior pair, the discrepancy being due mainly to the longer apical joint. The proportions of the spinnerets are of primary taxonomic value.

The well-developed tracheal system communicates with the outside by a single tracheal opening that is situated far in advance of the spinnerets. The spiracle is particularly large and conspicuous in *Neoantistea*. While its value as a family character has been fully recognized, the relative position of the spiracle on the abdomen has been neglected and seems to merit more attention in the definition of genera than has been accorded it. A comparison of thirteen species in this particular indicates that the four genera represented could easily be separated by this character alone. In the following ratios the measured distance of the spiracle from the genital furrow is taken as 1.00, and the distance of the spiracle from the base of the median spinnerets evaluated in terms of that number.

	MALE	FEMALE
<i>Bigois talei</i> Gertsch (Venezuela)	1:0.21	1:0.21
<i>Hahnia pusilla</i> C. Koch (Europe)	1:0.50	1:0.50
<i>Hahnia cinerea</i> Emerton	1:0.67	1:0.55
<i>Hahnia ernesti</i> Simon (West Indies)		1:0.33
<i>Hahnia okefinokensis</i> Chamberlin and Ivie	1:0.44	1:0.44
<i>Hahnia mengei</i> Chyzer and Kulczynski (Europe)	1:0.50	1:0.50
<i>Hahnia flaviceps</i> Emerton	1:0.68	1:0.98
<i>Antistea elegans</i> Blackwall (Europe)	1:1.00	1:1.29
<i>Antistea brunnea</i> Emerton	1:1.40	1:1.10
<i>Neoantistea agilis</i> Keyserling	1:2.33	1:2.00
<i>Neoantistea gosiuta</i> Gertsch	1:2.00	1:2.16
<i>Neoantistea riparia</i> Keyserling	1:2.68	1:1.85
<i>Neoantistea riparia</i> race <i>radula</i> Emerton	1:2.60	1:2.00
<i>Neoantistea barrowsi</i> Gertsch	1:2.42	1:3.00

Although all the Nearctic species were originally described in *Hahnia*, a survey shows that three genera are represented. A new generic name, *Neoantistea*, is proposed for a group of four species, including *Hahnia riparia* Keyserling, which was placed in *Antistea* by Simon. One American form, *H. brunnea* Emerton, conforms to *Antistea*. The representatives of these two genera are much stouter and considerably larger than most other hahniids. In addition, they have the eyes conspicuously larger, the anterior medians being quite as large or larger than the laterals. In *Hahnia* and related genera the anterior median eyes are greatly reduced in size, and in *Iberina*, a European cave form, none of the eyes are present. Only three species of *Hahnia* are known from the United States. *Hahnia okefinokensis* Chamberlin and Ivie is included in this paper through the courtesy of the authors, to whom I am further indebted for other valuable material. Eight species and two varieties represent the total number of forms at present known from the United States. A new species of *Bigois* is included for comparison.

KEY TO THE GENERA

- 1.—Anterior median eyes about as large or larger than the anterior laterals.2.
 Anterior median eyes considerably smaller than the anterior laterals.3.
- 2.—Spiracle midway between the genital opening and the base of the median spinnerets; distal joint of the lateral spinnerets shorter than the basal; male palpus with a femoral apophysisANTISTEA Simon.
 Spiracle twice as far from the base of the median spinnerets as the genital furrow; joints of lateral spinneret subequal; male palpus lacking femoral apophysis.NEOANTISTEA, new genus.
- 3.—Anterior median eyes minute; spiracle five times as far from the genital opening as the base of the median spinnerets; labium as long as broad.
 Bigois Simon.
 Anterior median eyes comparatively larger; spiracle only twice as far from the genital opening as from the base of the median spinnerets; labium broader than longHAHNIA C. Koch.

HAHNIA C. Koch

C. KOCH, 1841, 'Die Arachniden,' VIII, p. 61.

GENOTYPE.—*Hahnia pusilla* C. Koch.

Carapace convex, longer than broad. The eyes small, the anterior row procurved, subcontiguous, or slightly separated, the medians equal or smaller than the laterals. Posterior row of eyes slightly procurved, the medians smaller, farther apart. Median ocular quadrangle broader than long, narrowed in front, the posterior eyes larger. Lower margin of furrow of chelicerae with two, three, or four subequal denticles. Sternum longer than broad, rarely as broad as long (*mengeri*). Labium broader or as broad as long. Spiracle twice as far from the genital furrow as the base of the median

spinnerets, or midway (*flaviceps*). Distal joint of the lateral spinnerets usually shorter, sometimes nearly equal in length, than the basal.

Of the four species of *Hahnia* considered in this paper, three are Nearctic. At least thirteen are known from the Palearctic regions. The dearth of known American species is probably to be ascribed to the lack of large representative collections from all over the country. *Hahnia cinerea* Emerton is very common, widely distributed, and agrees very well with the genotype, *H. pusilla*, the palpus of that species differing chiefly in lacking the feathery apophysis on the bulb. The most divergent of the American species is *Hahnia flaviceps* Emerton, which, by virtue of the broad pars cephalica, heavier legs, submedian position of the tracheal spiracle, and the highly modified palpus, may deserve generic separation from the genus *Hahnia*.

KEY TO THE SPECIES OF *Hahnia*

- 1.—Posterior eye row half as broad as the pars cephalica at that point; carapace and legs unmarked; tibial apophysis long, not strongly curved.

H. flaviceps Emerton.

Posterior eye row two-thirds as wide or more than the pars cephalica at that point; carapace with at least marginal maculations; legs annulate or not. 2.

- 2.—Males. 3.

Females. 5.

- 3.—Tibial apophysis very short, straight.

H. okefinokensis Chamberlin and Ivie, new species.

Tibial apophysis strongly curved. 4.

- 4.—Legs sometimes darkened, but not annulate. *H. cinerea* Emerton.

Legs distinctly annulate in black. *H. cinerea seminola*, new race.

- 5.—Carapace pale, with marginal black maculations on the pars thoracica and a median black spot. 6.

Carapace dark, strongly marked with black radial striae; the head portion streaked. 7.

- 6.—Sternum slightly longer than broad. *H. ernesti* Simon.

Sternum broader than long. *H. okefinokensis* Chamberlin and Ivie, new species.

- 7.—Legs light, annulate. *H. cinerea seminola*, new race.

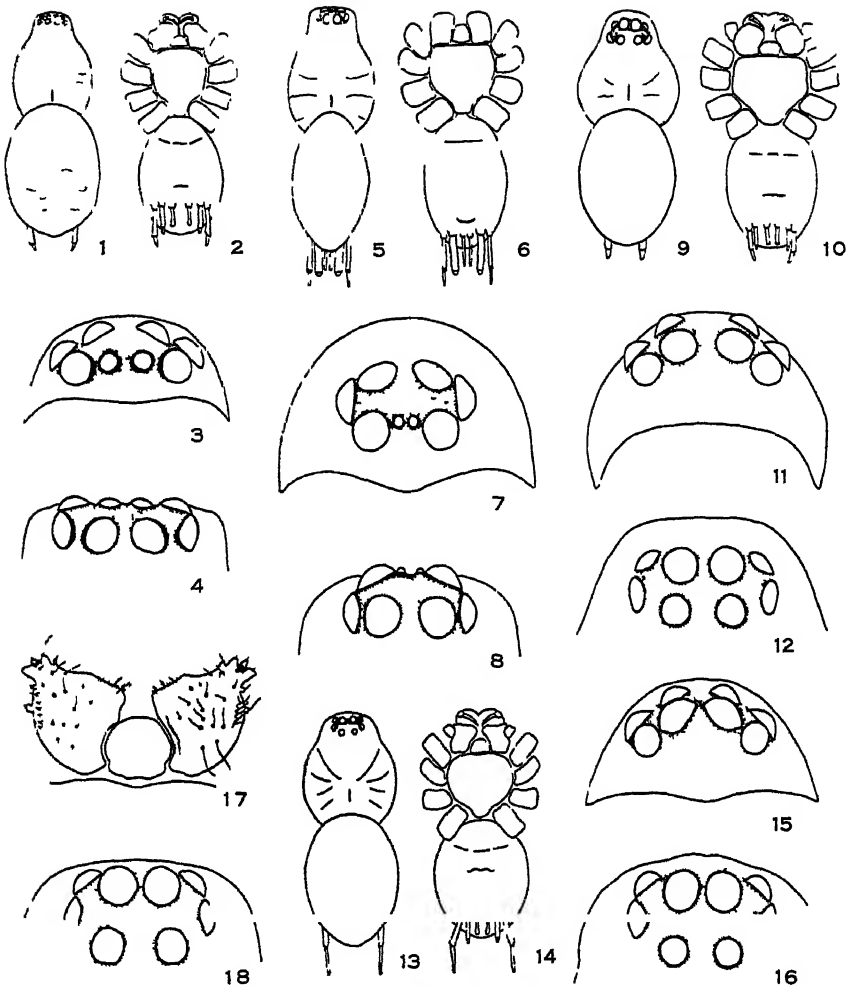
Legs dark, not annulate. *H. cinerea* Emerton.

***Hahnia cinerea* Emerton**

Figures 1, 2, 3, 4, 19, 20 and 21

Hahnia cinerea EMERTON, 1889, Trans. Connecticut Acad. Arts and Sci., VIII, p. 33, Pl. VII, figs. 9-9b.; 1894, p. 412; 1902, p. 1061, Fig. 252; 1913, p. 257. MARK, 1890, p. 517. BANKS, 1892, p. 27; 1902, p. 214; 1910, p. 15; 1932, p. 21. BRYANT, 1908, p. 79. PETRUNKEVITCH, 1911, p. 534. BISHOP AND CROSBY, 1926, pp. 203-204. CROSBY AND BISHOP, 1928, p. 1065. CHAMBERLIN AND IVIE, 1933, p. 49.

Hahnia species BANKS, 1895, p. 423; 1902, p. 214.



BODY OUTLINES AND EYE RELATIONS

Figs. 1, 2, 3, and 4. *Hahnia cinerea* Emerton.

Figs. 5, 6, 7, and 8. *Bigois tatei*, new species.

Figs. 9, 10, 11, and 12. *Antistea elegans* Blackwall.

Figs. 13, 14, 15, 16, and 17. *Neoantistea riparia* Keyserling.

Fig. 18. *Neoantistea riparia radula* Emerton.

Several males from Florida and Utah average 1.65 mm. in total length, the smallest, 1.45 mm. The females average slightly larger, 1.75 mm., though some are as small as the smallest males.

The integument of the carapace varies from light to dark brown, upon which is superimposed a characteristic pattern in black. In well-marked specimens the radial striae of the pars thoracica are broad bands, the caudal ones coalesced. In the middle of the carapace is an irregular, quadrangular maculation, from which extend two bands of black, one passing laterad to the posterior lateral eyes, the other, usually broken, going to the posterior median eyes. The carapace is margined by a black band that terminates after joining the band delimiting the side of the cephalic portion. The eye region is dark, and the clypeus is black or dusky.

The appendages of specimens from New England, Ohio, and Utah agree well with Emerton's color description: "The legs are light yellowish brown with patellae, coxae, and the ends of the longer joints paler than the others." The material from Florida, however, represents a striking color variety in which the legs are conspicuously annulate, the femora with basal and distal, the other joints with a sub-basal ring. In this color-form the sternum is usually darkened and marked by light maculations on the margins. In typical examples the sternum is dusky or black, the margins darker. The labium, endites, and coxae are usually, though not always, lighter than the sternum.

The abdomen in the typical form varies from gray to black and is marked by a double row of oblique or simple transverse bands of light color and numerous small light spots. A male from Ohio has the bands reduced to rows of small light spots. Specimens from Florida have the light bands greatly enlarged, especially caudally, the venter and sides with a speckled appearance. The spinnerets are usually light.

A male from Utah, 1.85 mm., was used as a basis for the following measurements.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	.85	.17	.52	.10	.20	1.05 mm.
Width	.66	.32	.47	.15	.22	.85 mm.

The cephalothorax is smooth and shining throughout, provided with a few small hairs on the clypeal margin. The decidedly longer than broad carapace is truncate behind, weakly rounded at the sides to the well-defined cephalic constriction, which is well behind the last eye row, the pars cephalica squared off in front. The cephalic portion is half as wide as the greatest width, is about the same height throughout, and gradually fades into the thoracic portion, which is nearly as high. The median suture is weakly indicated at a point two-thirds of the length back. The clypeus is two-thirds as high as the diameter of an anterior lateral eye.

The first eye row is narrower than the second in the ratio 32:38, procurved, a line through the center of the lateral eyes touching the lower margin of the medians, which are much smaller and a little farther apart than their distance to the laterals. The second row is slightly procurved, the medians farther apart than their distance from the laterals (5.5/4), as far from the anterior medians. Ratio of the eyes: ALE: AME: PLE: PME=8:5:9:8. The median ocular quadrangle is broader than long (20/18), narrower in front (20/13), the anteriors much smaller.

The parallel chelicerae are about twice as long as broad, little narrowed distally, and are armed above with two teeth, the lower margin with four small subequal teeth. The labium is two-thirds as long as broad, half as high as the endites. The longer than

broad sternum is truncate in front, widest between the first and second coxae, weakly rounded on the sides, and truncated between the last coxae, separating them by their width. A sparse covering of inconspicuous black hairs covers the ventral parts of the cephalothorax.

Leg formula, 4123. The first pair of legs are slightly stouter than the others, the femora a little incrassate at the base above.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.57	.25	.42	.42	.32	1.98 mm.
II	.52	.25	.40	.40	.32	1.89 mm.
III	.50	.22	.35	.40	.30	1.77 mm.
IV	.62	.25	.50	.52	.37	2.26 mm.
Palp	.25	.12	.10		.27	.74 mm.

Ratio of coxae I: II: III: IV = 100: 100: 85: 95.

Width of patella I, .10 mm. Tibial index, 14.

Width of patella IV, .082 mm. Tibial index, 11.

The legs are clothed with rows of black hairs, the only spines worthy of mention being one at the distal end of the patellae above, usually present on all the legs, and an occasional lateral or ventral spine on the tibiae.

The abdomen in the male is a little longer than broad and projects over the caudal margin of the carapace. The spiracle is located at a point much nearer the spinnerets than the genital furrow, the measurements being .67 mm. and 1.00 mm. The short median spinnerets (.15 mm.) are separated at base by their diameter from the two-jointed second spinnerets (basal joint .20 mm., the distal minute) which are subcontiguous with the lateral spinnerets (basal joint .25 mm., distal joint .15 mm.). The lateral spinnerets are placed a little higher on the abdomen than the others, the distal joint about half as long as the basal.

MALE PALPUS.—The femur is about equal in length to the patella and tibia taken together, which are scarcely as long as the tarsus. Near the middle of the patella on the outer side is a light-colored, curved spine. The tibial joint is provided on the retrolateral face with a strongly curved, slender apophysis that is distally roughened. The cymbium is longer than broad, hollowed to receive the comparatively simple bulbous parts. The embolus begins at the base on the outer side, encircles the bulb, and ends at the distal outer margin, where an inconspicuous conductor emerges from the bulb. An interesting feathery appendage is present near the base of the bulb on the prolateral side, which is characteristic of other species of *Hahnina*, as well as *cinerea*, notably *Hahnina mengi* of Europe.

A female from New Jersey measures 1.35 mm. and is used as a basis for the following measurements.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	.70	.16	.45	.10	.17	.68 mm.
Width	.52	.32	.39	.15	.17	.50 mm.

The sternum is longer than broad as in the male. The upper cheliceral margin is armed with two or three teeth, the lower with four small subequal denticles. Ratio of the eyes: ALE: AME: PLE: PME = 7: 5: 8.5: 7. The relations of the eyes agree well with the male, the quadrangle being broader than long (20/16), narrower in

front (14/20), the posterior medians separated from each other by less than a diameter, nearer the posterior laterals (3.5/5).

Leg formula, 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.54	.22	.38	.35	.27	1.76 mm.
II	.50	.22	.35	.35	.27	1.69 mm.
III	.47	.20	.32	.32	.25	1.56 mm.
IV	.60	.25	.50	.48	.32	2.15 mm.
Palp	.25	.11	.17		.37	.90 mm.

The abdomen is usually proportionately larger than in the male, the spiracle being placed much nearer the spinnerets than the genital furrow (4/7). The distal joint of the lateral spinnerets is .10 mm. long, scarcely half as long as the basal joint (.175 mm.). The second pair has the distal joint minute, the basal longer than the single joint of the middle spinnerets (.175 mm./1.37 mm.).

EPIGYNUM.—The details of the female reproductive organs are usually obscured by color markings. The atriobursal orifices are rather small and separated by twice or more their diameter. In *Hahnia menzei*, which the species closely resembles, the epigynum is very similar, the principle difference being in the greater separation of the atriobursal orifices.

DISTRIBUTION.—Maine: Long Island, August 27, 1906 (Bryant). New Hampshire: Lake Winnepesaukee (Bryant, 1908); North Woodstock, September, 1911; Fitzwilliam, May 24–30, 1907 (Bryant); Randolph, July 1, 1926 (Emerton). Massachusetts: Swampscott, February 1 (type locality of *cinerea*, Emerton, 1889); Salem, Beverly, Cambridge, Roxbury, Mt. Tom (Emerton, 1889); Brookline, Clarendon Hills (Bryant, 1908); Newton, April 6, 1904 (Bryant); Holliston, March 25, 1924 (Bryant); Carlisle Pines, October 26, 1907 (Bryant). Connecticut: New Haven (Emerton, 1889). New York: upper Cayuga Lake basin—Fall Creek, Buttermilk Creek (Banks, 1892); Wilmington Notch, August, Wilmington, August, Newcomb, July, Olcott, September, Ithaca, April, Freeville, August, Labrador Pond, June, Karner, March, Juanita Island, June, Little Pond, Orange County, May, Sam's Point, May, Riverhead, Long Island, April (Crosby and Bishop, 1928); Onondaga County, October 17, 1900 (Britcher). New Jersey: Farmingdale, May 3, 1912 (Emerton, 1913); Lakehurst, May 1, 1912 (Emerton). Virginia: Falls Church; Alexandria (Chamberlin). North Carolina: Walnut Creek, Raleigh, October 26, 1923 (Bishop and Crosby, 1926). Ohio: Columbus, June 12, 1916 (Barrows); Sugar Grove, July, 1915 (Barrows, 1918); Salineville; Hamden, May 1, 1926 (Barrows). Oklahoma: Cleveland County, March 31, 1930 (Banks, 1932). Colorado: Fort Collins (Banks, 1895). Utah: Clear Creek: south fork of Raft River; Dove Creek (Chamberlin and Ivie, 1933); Butterfield Canyon,

June 16, 1930 (Gertsch); Mill Creek; Logan Canyon (Chamberlin). Arizona: Williams, June 5 (Banks, 1902). Canada: Ontario—Ottawa (Emerton, 1894); Lake Megantic, July, 1916. Alaska: Ketchikan, August 29, 1922 (Marshall).

***Hahnia cinerea* race *seminola*, new race**

In addition to the differences in color cited above, this interesting variety has the eyes proportionately larger. The posterior median eyes are nearer together than in typical *cinerea*.

DISTRIBUTION.—Male holotype, female allotype, and male and female paratypes from Gainesville, Florida, February 27, 1927, the types deposited in the collection of The American Museum of Natural History through the courtesy of the collector, Dr. W. M. Barrows of Ohio State University.

***Hahnia okefinokensis* Chamberlin and Ivie, new species**

Figures 22 and 23

The male holotype measures 1.30 mm. in total length; the female allotype, 1.45 mm.; and a female paratype, 1.32 mm.

In the male the carapace is light yellow and, with the exception of the dark field enclosed by the eyes, has no distinguishing markings. The female has the carapace margined in black and has a dorsal black maculation at the median suture and four black markings at the position of the thoracic striae. The sternum is immaculate in the male but margined in black in the female. The legs, concolorous with the integument of the carapace, are annulate in the female, unmarked in the male. The abdomen is dirty white to gray, the sides dark, the dorsum with transverse chevrons in the female that are nearly obliterated in the male. The basal joint of the lateral spinnerets is broadly banded in black.

The following measurements are for the male.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	.60	.13	.37	.06	.16	.77 mm.
Width	.50	.30	.40	.10	.15	.57 mm.

The cephalothorax of the male is smooth and shining throughout and provided on the midline of the dorsum and in the eye area with several long black spines. The carapace is five-sixth as broad as long, the pars thoracica nearly round, delimited from the broad cephalic portion by a weak constriction. The moderately high pars cephalica grades gradually and almost imperceptibly into the thoracic portion. The sternum, about as broad as long, is clothed with regularly spaced, long black hairs. The labium is broader than long, three-eighths as long as the endites. The gently sloping clypeus is scarcely as high as the diameter of an anterior lateral eye. The chelicerae are armed below with two small subcontiguous teeth, the upper margin with three teeth.

The first row of eyes is narrower than the second in the ratio 30:36, procurved, the eyes as seen from above contiguous. The second row of eyes is less procurved, the medians farther apart than their distance from the laterals (7/3). Ratio of the

eyes: ALE:AME:PLE:PME=9:4:10:10. The median ocular quadrangle is broader than long (24/16), much narrower in front (24/12), the anterior median eyes much smaller.

The abdomen is oval, a little longer than broad. The spiracle is located much nearer the spinnerets (20/45) than the genital furrow. The spinnerets are placed as in other species of *Hahnia*, the distal joints of the lateral spinnerets shorter than the basal (3.5/5).

MALE PALPUS.—The femur is about equal to the patella and tibia taken together and is much longer than the tarsus (10/6). On the retrolateral basal face of the patella is a short retrorse spine, which is equal in length to the forwardly directed spur at the distal end of the tibial joint. The tarsus is little expanded, scarcely broader than the length of the tibia. The oval bulbal apparatus is two-thirds as long as the tarsus, and from its base on the prolateral sides originates the embolus, a slender tube that curves just around the distal end of the bulb.

The following measurements are for the female allotype.

	CARAPACE	FRONT	STERNUM	LABITUM	ENDITE	ABDOMEN
Length	.55	.12	.32	.07	.12	.92 mm.
Width	.47	.30	.40	.10	.12	80 mm.

The female agrees well with the male in color and in most structural features. The sternum is proportionately much broader than in the male. The endites are decidedly shorter as judged in comparison with the labium. The chelicerae are armed above and below as in the male, but the two teeth on the lower margin are not contiguous. The ratio of the eyes is equivalent, and the relations are the same. The spiracle is located much nearer the spinnerets than the genital furrow (7/16). The distal joint of the lateral spinneret is shorter than the basal. The atriobursal orifices of the epigynum are well separated as in *Hahnia cinerea* and *ernesti*, but other details of that organ are difficult to see.

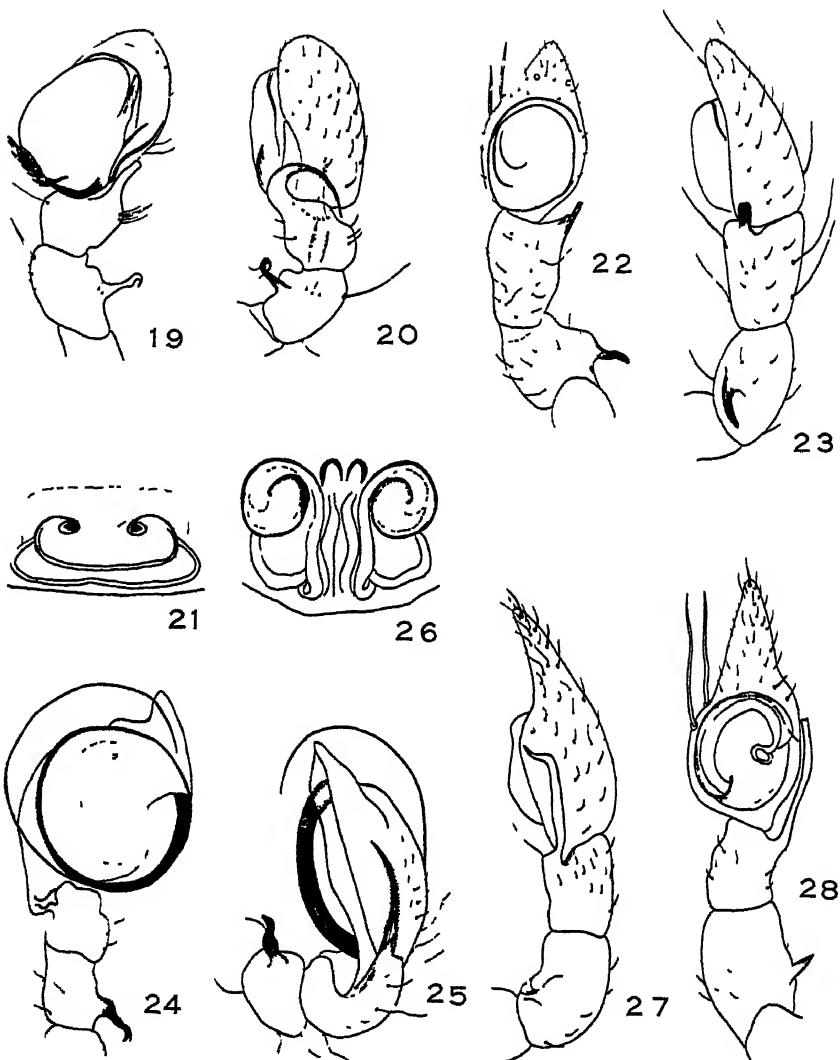
DISTRIBUTION.—Male holotype, female allotype and paratype from the east side of Okefinokee Swamp, Georgia. August 23, 1933, "from under bark scales of a large pine," collected by Mr. Wilton Ivie. The types are in the collection of the University of Utah; the female paratype in the collection of The American Museum of Natural History.

Hahnia ernesti Simon

Hahnia ernesti SIMON, 1897, Proc. Zool. Soc. London, p. 888. PETRUNKEVITCH, 1929, Trans. Connecticut Acad. Arts and Sci., XXX, pp. 78-79, Figs. 67 and 68.

Total lengths of two females, 1.70 mm. and 1.75 mm.

The male was described by Simon in 1897, but it is not represented in our collection. In the 'Spiders of Porto Rico' Petrunkevitch has given a good description of the female. His figure shows the prominent dark markings at the margins of the yellow carapace and the central maculation just anterior to the median cephalic suture. The eyes enclose a black field. The sternum and mouth parts are yellow as is the integument of the distinctly annulate legs. This species agrees well with *Hahnia okefinokeensis* in coloration but differs in some structural details. The first female mentioned above is taken as the basis for the following structural diagnosis.



PALPI AND EPIGYNA

Figs. 19, 20, and 21. *Hahnia cinerea* Emerton.

Figs. 22 and 23. *Hahnia okefnokensis* Chamberlin and Ivie, new species.

Figs. 24, 25, and 26. *Hahnia flaviceps* Emerton.

Figs. 27 and 28. *Bigoia tatei*, new species.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	65	15	.40	10	.20	1 03 mm.
Width	.54	.30	.35	13	13	83 mm.

The longer than broad carapace has lost the customary covering of hairs. The head portion is clearly demarked from the pars thoracica and is somewhat higher and more convex than in *Hahnia okefnokensis*. The sternum is clearly longer than broad. The lower margin of the furrow of the chelicera is armed with two teeth.

The first row of eyes is narrower than the second in the ratio 30:38, procurved, but appearing straight from above, the eyes subcontiguous. The second row of eyes is procurved, the medians farther apart than their distance to the laterals (7/3). Ratio of the eyes: ALE: AME: PLE: PME=9: 6: 10: 10. The median ocular quadrangle is broader than long (23/19), much narrower in front (29/12). The clypeus is about two-thirds as high as the diameter of an anterior median eye. Leg formula, 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.50	.20	.42	32	.27	1.71 mm.
II	.50	.20	.35	.30	.27	1.62 mm.
III	.40	.17	.32	.27	.25	1.41 mm.
IV	.55	.22	.47	.42	.31	1.97 mm.
Palp	.17	.10	.15		.20	.62 mm.

Ratio of coxae I: II: III: IV = 8: 7: 6: 7.

Width of patella I, .75 mm. Tibial index, 12.

Width of patella IV, .62 mm. Tibial index, 9.

The spiracle is located much nearer the spinnerets than the genital furrow (.15 mm./45 mm.). The median spinnerets are short (.12 mm.) and diverge slightly from each other. The basal joint of the second pair is .17 mm. long, slightly shorter than the basal joint of the lateral spinnerets (.20 mm.), the distal joint of which is .17 mm. long, slightly shorter than the basal. The epigynum of the female is indistinguishable from that of *Hahnia okefnokensis*, the atriobursal orifices being well separated as in that species.

DISTRIBUTION.—St. Vincent, West Indies (Simon, 1897). Puerto Rico: Naguabo, March 7, 1914; Adjuntas, June 8–13, 1915 (Petrunkovitch, 1929).

Hahnia flaviceps Emerton

Figures 24, 25 and 26

Hahnia flaviceps EMERTON, 1913, Bull. Amer. Mus. Nat. Hist., XXXII, p. 257, Pl. XLVIII, figs. 6–6d. BISHOP AND CROSBY, 1926, p. 203.

The total length of the male type is 1.68 mm., the female type, 2.00 mm.

Both sexes are alike in color. The eyes enclose a black field, but the rest of the carapace and the legs are unmarked, light yellowish-brown. The dorsum of the abdomen is provided with gray chevrons, the venter lighter. The light yellow spinnerets are not annulate. The following measurements are for the male.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	.72	.17	.50	.10	.20	1.05 mm.
Width	.65	.30	.45	.15	.17	.75 mm.

The cephalothorax has been rubbed but was apparently provided with spines in the eye area and on the midline of the carapace. The longer than broad carapace is convex and shows little differentiation between the thoracic and cephalic parts. It is about equal in height from the eyes to the median suture, which begins two-thirds of the distance back. The slightly longer than broad sternum is sparsely clothed with black hairs. The clypeus is sloping, considerably more so than in most other species of *Hahnia*, and is equal in the male to twice the diameter of an anterior lateral eye. The lower margin of the furrow of the chelicera is armed with three subequal teeth, the upper with four unequal denticles.

The first row of eyes is narrower than the second in the ratio 29:38, procurved, but appearing straight from above, the eyes subcontiguous. The second row of eyes is procurved, the medians farther apart than their distance from the laterals (7/3). Ratio of the eyes: ALE: AME: PLE: PME=9:6:9:8. The median ocular quadrangle is broader than long (24/16), narrower in front (12/24), the anterior medians smaller.

Leg formula, 4123. The legs are much stouter than in most species of *Hahnia* as indicated by the Tibial Indices and are provided with a few spines and a sparse clothing of hairs.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.62	.25	.37	.30	.22	1.76 mm.
II	.57	.25	.36	.30	.22	1.70 mm.
III	.45	.22	.30	.35	.22	1.54 mm.
IV	.57	.25	.45	.42	.30	1.99 mm.
Palp	.22	.17	.25		.35	.99 mm.

Ratio of coxae I: II: III: IV=11: 11: 9: 10.

Width of patella I, .112 mm. Tibial index, 18.

Width of patella IV, .087 mm. Tibial index, 12.

The spiracle is located at a point nearer the spinnerets than the genital furrow (.22 mm./32 mm.). The lateral spinnerets have the basal joint (.20 mm.) longer than the distal (.12 mm.). The basal joint of the second pair is .16 mm. long, that of the medians equal in length to the distal joint of the lateral pair.

MALE PALPUS.—The femur is scarcely as long as the tibial joint. A retrorse spur is present on the retrolateral side of the patella near the base that is weakly notched at the tip. The tibia is highly modified, overlapping the cymbium to some extent, and is provided with a conspicuous black, toothed spur on the retrolateral side that is two-thirds as long as the cymbium (nearly as long as the cymbium in the male from Columbus, Ohio). Distally the cymbium is modified for the reception of the tube. The bulbal elements are comparatively simple, the embolic tube beginning near the medial prolateral margin, supported to the base of the bulb by a transparent conductor, and then completely encircling the periphery of the bulb to come to rest on the distal cymbial fold.

The following measurements are for the female type.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	.80	.15	.47	.09	.20	1.25 mm.
Width	.52	.37	.42	.17	.17	.82 mm.

In the female the carapace is decidedly longer than broad, and the cephalic portion is more clearly differentiated from the pars thoracica than in the male. The eyes have the same relationship as in the other sex and are proportionately equal in size. The clypeus is only as high as the diameter of an anterior lateral eye. The leg formula is 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.50	.25	.31	.27	.22	1.55 mm.
II	.45	.25	.31	.27	.22	1.49 mm.
III	.40	.22	.25	.25	.21	1.33 mm.
IV	.50	.25	.40	.37	.30	1.82 mm.
Palp	.21	.10	.12		.20	.63 mm.

Width of patella I, .10 mm. Tibial index, 18.

Width of patella IV, .075 mm. Tibial index, 11.

The spiracle is located at the middle of the abdomen, exactly between the genital furrow and the base of the median spinnerets. The distal joint of the lateral spinnerets is shorter than the basal (.12 mm./ .20 mm.).

EPIGYNUM.—Emerton's figure of the epigynum of this species is reversed on the plate. The organ is well developed, and the details are easily visible through the outer sclerotic covering. The atrio-bursal orifices are close together at the middle of the greatly expanded bursa copulatrix. The complicated arrangements of the intermediate tubules is best shown by a figure.

DISTRIBUTION.—New Jersey. "Under leaves in a swamp near the railroad station at Farmington," May 3, 1912 (type locality of *flaviceps*, Emerton, 1913). Ohio. Columbus, spring, 1932, one male (Barrows).

Bigois Simon

SIMON, 1898, 'Histoire Naturelle des Araignees,' II, p. 277.

GENOTYPE.—*Bigois myops* Simon.

Carapace convex, longer than broad. Eyes large, the anterior row procurved, subcontiguous, the medians minute. Posterior row of eyes slightly procurved, equal in size, the medians farther apart. Median ocular quadrangle broader than long, narrower in front. Chelicerae armed with three subequal teeth on the lower margin. Sternum slightly longer than broad. Labium as long as broad. Spiracle five times as far from the genital furrow as the base of the median spinnerets. The distal joint of the lateral spinnerets very short, the spinnerets proportionately longer than in *Hahnia*.

The generic name *Bigois* is used for the species described below on the strength of the description of a species by Simon from Terra del Fuego, *B. antarctica*. The genotype is from the Philippine Islands. *Neohahnia* Mello-Leitao seems to be closely allied to *Bigois*.

Bigois tatei, new species

Figures 5, 6, 7, 8, 27, and 28

The male holotype is 2.42 mm. in total length, the female allotype, 2.32 mm.

The carapace and legs are light yellowish-brown in both sexes, without contrasting markings of any sort, with the exception of the black field enclosed by the eyes.

The abdomen is gray throughout, immaculate, the distal end of the basal joint of the lateral spinnerets dusky. The following measurements and the structural description are for the male.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1 17	.25	67	.17	.32	1 25 mm.
Width	.85	50	65	.17	25	1 12 mm.

The spines of the cephalothorax have been broken off, for the most part, leaving no trace of their normal number or position. The decidedly longer than broad carapace is highest just behind the eyes and remains on nearly the same plane caudad to the median suture, which is placed far back. The convex thoracic portion is nearly round and grades gradually into the broad, rather long pars cephalica, which is truncate in front. The sternum is as broad as long, is truncated in front, evenly rounded on the sides, ending in a blunt point between the last coxae, which are separated by their width. The labium, which is equal in height to its breadth, is about half as long as the longer than broad endites. The mouth parts and sternum are clothed sparsely with black hairs. All the legs of the male have been broken off. The chelicerae are provided near the claw on the outer side with several feathery hairs. The lower cheliceral margin is armed with three small teeth, the upper with three larger ones.

The first row of eyes is narrower than the second in the ratio 24:31, appearing straight from above, but decidedly procurved as viewed from in front, the eyes about equally spaced, almost contiguous. The second row of eyes is procurved, the eyes subequal, the medians about one-half a diameter apart, almost touching the laterals. Ratio of the eyes: ALE:AME:PLE:PME=17:4:17:17. The median ocular quadrangle is much broader than long (41/30), narrower in front (41/12), the anterior medians minute.

The longer than broad abdomen is well rounded at both ends. The spiracle is situated very much nearer the spinnerets than the genital furrow (.15 mm./70 mm.). The basal joints of the spinnerets are proportionately much longer than in *Hahnia*. The basal joint of the lateral pair (.30 mm. long) is slender, much less robust than that of the second, which is quite as long, the median spinneret being somewhat shorter (.22 mm.). The distal joint of the lateral pair (.12 mm.) is less than half as long as the basal joint.

MALE PALPUS.—The femur is about two-thirds as long as the rest of the appendage. A short laterally directed spur is present at the base on the prolateral face of the expanded patella. The tibial joint has a long bladeliike apophysis on the outer side that is curved at the end. The tarsus is longer than broad, not highly modified, the bulbal elements rather simple. The embolus is a slender tube that lies in a fold at the distal end of the bulb.

The female agrees well with the male in all important structural details. As all the specimens are badly mutilated, a more detailed diagnosis is dispensed with.

DISTRIBUTION.—Male holotype, female allotype, and a male and female paratype from Mt. Duida, Venezuela (Tate, collector).

ANTISTEA Simon

SIMON, 1898, 'Histoire Naturelle des Araignees,' II, p. 275.

GENOTYPE.—*Antistea elegans* (Blackwall).

Carapace convex, nearly as broad as long. Eyes large, the first row procurved as viewed from in front, the eyes equidistantly spaced, the medians as large as or larger than the laterals. Posterior row of eyes slightly procurved, the medians farther apart, equal (*brunnea*) or smaller (*elegans*) than the laterals. Median ocular quadrangle as broad as long, the eyes subequal or the posterior medians smaller. Chelicerae armed with three subequal teeth on the lower margin. Sternum and labium broader than long. Tracheal spiracle situated about midway between the genital opening and the base of the median spinnerets. Spinnerets short, the distal joint of the lateral pair shorter than the basal.

Only one of the American species conforms fully to the definition of *Antistea* as given by Simon. The remarkable similarity between *A. brunnea* Emerton and *A. elegans* in regard to characters of the palpus and epigynum is a sound index of their phylogenetic proximity.

***Antistea brunnea* (Emerton)**

Figures 31, 32 and 33

Hahnia brunnea EMERTON, 1909, Trans. Connecticut Acad. Arts and Sci., XIV, pp. 223–224, Pl. VII, Fig. 5. BANKS, 1910, p. 15. PETRUNKEVITCH, 1911, p. 534. CROSBY AND BISHOP, 1928, p. 1065.

A male from Maine measures 2.25 mm. and one from Alaska 2.20 mm. in total length. A female from Minnesota is 2.65 mm. long, the type from Massachusetts, 2.57 mm.

The integument of the carapace is light yellowish-brown and shows only faintly the radiating darker streaks present on the pars thoracica. The posterior median eyes are not ringed in black, but the others are in a black field, the clypeal region also somewhat darkened. The sternum and labium are slightly darker than the endites and coxae, these latter being a light grayish-brown and concolorous with the legs and palpi, which lack annulae or contrasting markings of any sort.

A third of the way back from the base of the abdomen above are the small orange spots, indicating the internal muscular attachments. The integument of the dorsum is light, and the slightly darker pattern of zigzag chevrons offer little contrast, the sides being darker. The venter is dark gray and the spinnerets are grayish brown.

The male from Alaska was used as a basis for the following measurements.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.05	.75	.60	.15	.25	1.30 mm.
Width	.92	.37	.70	.22	.25	1.07 mm.

Measurements of a female from Minneapolis, Minnesota.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.05	.30	.60	.10	.25	1.75 mm.
Width	.90	.50	.70	.19	.25	1.27 mm.

The cephalothorax is smooth and shining and devoid of hairs and spines except on the margins of the clypeus. The rest of the specimens are rather evenly and



PALPI AND EPIGYNA

- Fig. 29. *Neoantistea agilis* Keyserling.
 Fig. 30. *Neoantistea gosiuta*, new species.
 Figs. 31, 32, and 33. *Antistea brunnea* Emerton.
 Figs. 34 and 35. *Antistea elegans* Blackwall.
 Figs. 36 and 37. *Neoantistea barrousi*, new species.
 Figs. 38, 39, and 40. *Neoantistea riparia* Keyserling.
 Fig. 41. *Neoantistea agilis* Keyserling.
 Fig. 42. *Neoantistea gosiuta*, new species.

sparingly covered with black hairs. The carapace is somewhat longer than broad, truncate behind, broadly rounded on the sides to a point just behind the second eye row where a well-marked constriction delimits the cephalic portion, the front gently rounded. The width of the front is one-half the greatest width. The pars cephalica is highest just behind the area of the eyes, is moderately convex, the juncture between it and the less convex, nearly round thoracic portion fairly well marked. The median cephalic suture is located four-fifths of the length back. The clypeus is nearly vertical and equal in height to the diameter of an anterior lateral eye.

The first row of eyes is a little narrower than the second in the ratio 51: 55, is strongly procurved, the eyes being nearly equidistant. The second row of eyes is less procurved, the medians nearer the laterals than themselves in the ratio 5: 9. Ratio of the eyes: ALE: AME: PLE: PME=16: 15: 12: 12. The eyes are not very dissimilar in size. The median quadrangle is about as long as broad (30'32), slightly narrower in front in the ratio 29: 32, the larger anteriors separated by one-fifth diameter, the posterior medians by three-fourths of a diameter. The anterior median eyes of the male are slightly larger than in the female.

The parallel chelicerae, which are twice as long as broad, have a number of strong, curved hairs at the distal end and have two unequal teeth on the upper margin. The lower margin of the right chelicera has the conventional three small subequal denticles, the left, however, with four, the additional one considered abnormal. The endites are provided with a band of hairs at the distal end on the inner side, and are over twice as long as the broader than long labium (.19 mm. '10 mm.). The sternum is broader than long, truncated behind, between the last coxae, which are separated by their width, squared off in front and at that point nearly equal to the greatest width. The lateral margins of the sternum and the distal end of the labium are armed with strong black hairs.

Leg formula, 4123. The first three pairs of legs are subequal, the last pair a little longer and more slender as indicated by the tibial indices.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.75	.30	.57	.55	.42	2.59 mm.
II	.72	.30	.57	.55	.42	2.56 mm.
III	.70	.29	.54	.55	.44	2.52 mm.
IV	.84	.31	.77	.76	.57	3.25 mm.
Palp	.30	.15	.24		.40	.99 mm.

Ratio of coxae I: II: III: IV=12: 12: 12: 13.

Width of patella I, .125 mm. Tibial index, 14.

Width of patella IV, .112 mm. Tibial index, 10.

The legs are sparsely clothed with short hairs and weak spines, those beneath the anterior femora more highly developed. The patella is provided at the distal end above with a spine, as in *agilis*, which seems to be a constant feature, but a dorsal basal or distal spine on the tibia and a prolateral or retrolateral one on the same joint may or may not be present.

The well-rounded abdomen is longer than broad. The spiracle is located nearly at a mid-point between the genital furrow and the base of the middle spinnerets in the female, slightly nearer the genital opening in the male (.25 mm./ .37 mm.). The area of the spinnerets is about as wide as the width of the sternum. The lateral pair has the distal joint much shorter than the basal, in the ratio of .2 mm.: .1 mm. and is

longer than the second pair in which the distal joint is greatly reduced. The basal joints of the lateral, second, and middle spinnerets measure in millimeters .20, .17 and .14, respectively. In the male the distal joint of the lateral spinneret is half as long as the basal. The lateral spinnerets are placed slightly above the others, subcontiguous with the second pair, which are one-third their diameter from the subcontiguous medians.

EPIGYNUM.—The epigynal area is broader than long and scarcely two-thirds the breadth of the sternum. The conspicuous features are the paired atriobursal orifices, which are large and nearly contiguous, nearly round in outline. Traces of an intermediate narrow coiled tube can be seen through the sclerotic covering, apparently leading to the receptaculum seminis, which cannot be made out without dissection. *Antistea elegans*, the genotype, differs chiefly in the angular atriobursal orifices.

MALE PALPUS.—The remarkable similarity between the palpi of *A. elegans* and *brunnea* is a good index of their phylogenetic proximity. *A. propinqua* Simon, a second European species, differs only in the length of the femoral apophysis. The femur is about as long as the tibia and patella taken together and has a subventral spur that is about as long as the width of the joint. In *elegans* it is more slender and a little longer. The patella is considerably expanded in both species, the femoral articulation being at right angles to the joint. A small black spur at the distal end of the patella, present in *elegans*, is lacking in the American species. The small tibia has on the outer side a large sclerotized black apophysis which is more or less straight in *elegans* and greatly curved in *brunnea*. The cymbium is a little longer than broad, oval, the conspicuous feature being the embolic portion. It becomes free of the bulb near the distal end on the outer side, is somewhat supported from there to the base by a colorless conductor, curves around the periphery of the cymbium, and terminates in a groove on the retrolateral cymbial margin. The character of the groove is different in the two species, as shown in the figures.

DISTRIBUTION.—Maine: Island Falls, July 20, 1914 (Emerton). New Hampshire: Hanover (type locality of *brunnea*, Emerton, 1909). New York: Cinnamon Lake, June-July; Freeville, April-August; McLean, May; Little Pond, Orange Co., May (Crosby and Bishop, 1928); Ithaca (Emerton); Onondaga County (Britcher). Minnesota: Minneapolis, April 26, 1932 (Gertsch). Alaska: Ketchikan, August 29, 1922 (Marshall).

NEOANTISTEA, new genus

GENOTYPE.—*Neoantistea agilis* (Keyserling)

Carapace convex, about as broad as long. Eyes large, the anterior row procurved, straight from above, the medians slightly smaller, equal to, or larger than the laterals, equidistantly spaced. Posterior row of eyes slightly procurved, the medians farther apart, equal to or smaller than the laterals. Median ocular quadrangle as broad as long, the anterior eyes subequal or larger than the posterior medians. Lower margin of the furrow of the chelicerae with three subequal teeth in the females, a single large tooth in the males (except *agilis* and *gosiuta*). Sternum large, as broad as or broader than long. Labium broader than long. Spiracle twice as far from the

base of the median spinnerets as to the genital furrow. Spinnerets longer than in *Antistea*, the basal and distal joints of the lateral pair subequal.

As defined above, the genus *Neoantistea* is strictly Nearctic, no comparable forms being known from other regions. Four well-marked species are treated in this paper, and one, *N. radula* Emerton, is considered as an eastern race of the western *N. riparia* Keyserling.

KEY TO THE SPECIES OF *Neoantistea*

- 1.—Males. 2.
Females. 6.
- 2.—Lower cheliceral margin with three subequal teeth; patellar spur a strong spine more than half as long as the tibial apophysis. 3.
Lower cheliceral margin with a single large tooth; patellar spur greatly reduced 4.
- 3.—Tibial apophysis gently curved, directed laterad. *N. agilis* (Keyserling).
Tibial apophysis strongly curved caudad. *N. gosiuta*, new species.
- 4.—Tibial apophysis slender throughout its length. 5.
Tibial apophysis considerably expanded. *N. barrowsi*, new species.
- 5.—Anterior median eyes not much larger than the posterior medians.
N. riparia race *radula* (Emerton).
Anterior median eyes considerably larger than the posterior medians.
N. riparia (Keyserling).
- 6.—Intermediate canal of epigynum much narrower than the width of the seminal receptacle. 7.
Intermediate canal of epigynum as broad as the width of the seminal receptacle. 9.
- 7.—Intermediate canal not convoluted. Utah. *N. gosiuta*, new species.
Intermediate canal convoluted. East and South. 8.
- 8.—Posterior median eyes about one diameter apart. *N. agilis* (Keyserling).
Posterior median eyes one and one-half diameters apart.
N. barrowsi, new species.
- 9.—Anterior median eyes not much larger than the posterior medians.
N. riparia race *radula* (Emerton).
Anterior median eyes much larger than the posterior median eyes.
N. riparia (Keyserling).

Neoantistea agilis (Keyserling)

Figures 29 and 41

Hahn timer agilis KEYSERLING, 1887, Verh. k. k. zool.-bot. Gesell., Wien, XXXVII, pp. 465-467, Pl. VI, fig. 29. MARX, 1890, p. 517. BANKS, 1895, p. 82. SLOSSON, 1898, p. 247. BRYANT, 1908, p. 78. BANKS, 1910, p. 15. BANKS, 1911, p. 443. PETRUNKEVITCH, 1911, p. 534. BARROWS, 1918, p. 301. BISHOP AND CROSBY, 1926, pp. 203-204. CROSBY AND BISHOP, 1928, p. 1065.

Hahn timer bimaculata EMERTON, 1889, Trans. Connecticut Acad. Arts and Sci., VIII, p. 32, Pl. VII, figs. 8, 8a-8f. MARX, 1890, p. 517. BANKS, 1892, p. 27; 1893, p. 125. EMERTON, 1894, p. 412; EMERTON, 1902, p. 105. BANKS, 1916, p. 443.

The total lengths of four males from two localities are 2.37 mm., 2.42 mm., 2.25

mm., and 2.62 mm., an average of 2.41 mm. Five females measure 2.95 mm., 3.25 mm., 2.75 mm., 2.65 mm., and 3.00 mm., respectively, an average length of 2.92 mm.

The integument of the cephalothorax varies from light reddish-brown to dark chestnut, the pars cephalica appearing lighter. Black streaks radiate from the median cephalic suture, define the cephalic portion, and with an indistinct dark narrow marginal band make up the vague pattern of the carapace. The posterior median eyes are not ringed in black, all the others being in a black field. The sternum and labium are light to dark brown, the margins of the latter darker, the coxae and endites unmarked yellow. A conspicuous feature of the legs are the dark annulae, placed on the light yellow integument of each joint near the base and at the distal end, the only exception being the patella with a single ring and the lack of a distal one on the tarsus. These annulae are not completely obliterated in any specimen that I have seen so far, though in some cases they become faint or are broken above or below.

The pattern of the abdomen varies considerably in the depth of chromatism, the more or less constant features being five or six zigzag chevrons at the posterior half of the dorsum, through the middle of which is a longitudinal streak. The integument is gray, but the black markings often obscure any lighter color. About a third of the way back from the base are the two orange spots, the points of the muscle attachments beneath. The venter is much lighter, the constant color markings being a transverse black band across the region of the spiracle and a longitudinal dash of black from near the spiracle to the side spinnerets. The lateral and second spinnerets are black at the distal end.

A male from Bowling Green, Kentucky, measures 2.62 mm. and is used as the basis for the structural description and the measurements below.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.30	.35	.72	.17	.30	1.50 mm.
Width	1.12	.62	.77	.25	.27	1 20 mm.

The cephalothorax is smooth and shining and is almost devoid of hairs or spines of any sort, and these, when present, minute. The carapace is slightly longer than broad, truncated behind, the sides gently rounded to a point just behind the second eye row, where a weak constriction delimits the cephalic portion, the width at the weakly rounded front being nearly one-half the greatest width. The pars cephalica is moderately high, convex, and drops caudally rather gradually to the longitudinal furrow, which is located at a point four-fifths of the length of the carapace back. The sides of the pars thoracica are convex and blend into the head part without the intervention of well-defined sulci. The clypeus is almost vertical and equal in height to the diameter of an anterior lateral eye.

The first row of eyes is very slightly shorter than the second (142/150) and, although appearing straight from above, is strongly procurved, the line on the lower edge of the medians cutting a very small part of the upper edge of the laterals. The second row of eyes is less procurved. Ratio of the eyes: ALE: AME: PLE: PME = 15: 17: 13: 11. The eyes of the first row are about equidistantly spaced, the eyes larger than those of the second row and closer together, separated by about one-fourth of a diameter (4/17), the medians larger. The posterior median eyes are much nearer the laterals (6/16). The median ocular quadrangle is narrower in front (34/37) and broader than long in the ratio 37: 35, the anterior medians much larger.

The chelicerae are somewhat more than twice as long as broad, parallel, not much

wider at the base than distally, the upper margin with two unequal teeth above and a dentate sclerotized carina along the inner surface, the lower margin with three small subequal denticles. The broader than long labium is a little more than half as long as the endites, which are slightly convergent and provided with a band of hairs on the distal inner margin, the outer with two or three small tubercles from which short hairs project. The sternum is provided with a sparse covering of short black hairs and is slightly broader than long, widest at the second coxae, truncate in front and bluntly pointed caudally between the last coxae, separating them by their width.

Leg formula, 4123. The third pair of legs is three-fourths as long as the fourth, the longest pair, which is a little more slender than the others.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.92	.40	.70	.62	.40	3.04 mm.
II	.85	.37	.62	.62	.40	2.86 mm.
III	.77	.36	.55	.62	.43	2.73 mm.
IV	.97	.37	.80	.87	.52	3.53 mm.
Palp	.50	.25	.16		.46	1.37 mm.

Ratio of coxae I: II: III: IV: = 18: 16: 14: 16.

Width of patella I, .150 mm. Tibial index, 13.

Width of patella IV, .125 mm. Tibial index, 10.

The spines on the legs of this species are poorly developed, and mention need be made only of the double row of bristles beneath the anterior femora which originate from slight tubercles, the almost invariable presence of a spine at the distal end of the patella above and an occasional one at the middle of the tibia beneath. The legs are clothed with rows of black hairs.

The abdomen is oval in outline as seen from above and not much longer than broad, well rounded at both ends, and projects slightly over the carapace in front. The spiracle is situated at a point much nearer the genital furrow than the spinnerets (3/7). The spinnerets are in a transverse line, about as wide at the base as the width of the sternum. The lateral pair, with equal basal and distal joints (.25 mm. each), is much longer than the second (basal joint .25 mm.) in which the distal joint is minute. The lateral pair is placed slightly above but nearly contiguous at the base with the second pair. The one-jointed median spinnerets (.175 mm.) are separated from each other by a diameter and are half as far from the second pair.

MALE PALPUS.—The femur is longer than the patella and tibia taken together and about equal in length to the tarsus. The patella is longer than the tibia and is provided near its base with a fine curved retrolateral spine that is directed forward and is much longer than the corresponding spine in *riparia*. The tibia is only two-thirds as long as the patella and has on the retrolateral distal margin a spur that is half the width of the joint and is directed obliquely outward. The cymbium is a little longer than broad and is shallowly hollowed to enclose the nearly circular bulbal apparatus. After encircling the margin of the bulb as a heavy tube, usually visible through the chitin, the seminal canal gradually diminishes in size, makes a prominent loop at an oblique angle on the retrolateral side and then joins with the embolic portion. The embolus, supported at the base by a colorless pars pendula, originates near the base of the cymbium, curves around the periphery of the bulb as a fine tube, terminating after completing nearly a full turn.

The following measurements are from a female from Onondaga County, New York, that is 2.95 mm. long.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1 25	30	75	.17	.27	1 75 mm.
Width	1 05	67	77	24	25	1 32 mm.

The chelicerae are armed on the upper margin with three unequal teeth, the third in this specimen distinct from the inner marginal carina. On the lower margin are three small subequal teeth as in the male.

Ratio of the eyes: ALE: AME: PLE: PME = 17: 19: 12: 12. The first row is slightly narrower than the second in the ratio 30: 32, strongly procurved, the eyes equidistantly spaced one-sixth of a diameter apart and not particularly dissimilar in size. Second row of eyes somewhat less procurved, subequal, the medians twice as far apart as their distance from the laterals (ratio 24: 13). The median ocular quadrangle is slightly narrower in front (35/37) and about as long as broad (38/37), the posterior medians one diameter apart, half as far from the anterior medians, which are larger (19/12). The posterior median eyes are subject to some variation in specimens from the same and from different localities. The clypeus is as high as an anterior lateral eye.

The legs are weakly spined as in the male and provided with the customary rows of black hairs. The formula is 4123 as in the male, the third pair being about three-fourths as long as the fourth.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.85	.37	.60	.57	.42	2 81 mm.
II	.81	.37	.57	.57	.42	2 74 mm.
III	.75	.37	.50	.62	.42	2 66 mm.
IV	1 00	.37	.77	.85	.57	3 56 mm.
Palp	.42	.20	.25		.42	1.29 mm.

Ratio of the coxae I: II: III: IV = 17: 16: 14: 16.

Width of patella I, .150 mm. Tibial index, 15.

Width of patella IV, .125 mm. Tibial index, 11.

The abdomen is oval in outline and about three-fourths as broad as long, the ends well rounded. The spiracle is situated twice as far from the spinnerets as the genital furrow (.325 mm./ .650 mm.). Although the transverse basal width of the area of the spinnerets is wider than the sternum, the spinnerets are arranged exactly as in the male, the proportions being about equivalent: basal and distal joints of lateral spinnerets equal (.30 mm.), basal joint of second pair, .25 mm., of middle pair, .20 mm.

EPIGYNUM.—The female genital organ is composed of two more or less symmetrical units, two highly modified tubes, opening externally through the fertilization canals into the genital furrow and the paired atriobursal orifices. The structure, which is two-fifths as broad as the sternum, is covered by a thin sclerotic coat, through which the internal details are usually plainly visible. The atriobursal orifices are usually well separated, as shown in the figure, and open into a convoluted, expanded portion termed the bursa copulatrix. An intermediate narrow coil makes two loops between the receptacula seminis, another expanded portion from which the fertilization canals originate. The narrow intermediate coils are subject to much variation in position, and some of these variations have been figured by Emerton (Trans. Con-

necitac Acad. Arts and Sci., VIII, Pl. VII, figs. 8c-8f.). The proportions between these tubes and the breadth of the seminal receptacles are, however, constant.

DISTRIBUTION.—Maine: Isle-au-Haut (Bishop); Moosehead Lake, Bayville (Bryant, 1908). Vermont: Stowe (Bryant, 1908); South Newfane, June, 1926. New Hampshire: Franconia (Slosson, 1898); Jackson, Lake Winnepesaukee (Bryant, 1908); Mt. Washington (Emerton, 1889). Massachusetts: Salem, December 9, 1877 (type locality of *bimaculata*, Emerton, 1889); Ponkapoag Pond, August 25, 1926 (Emerton); Holliston, September 15, 1928; Gloucester, April 19, 1909 (Bryant); Monponsett, June 12, 1912 (Emerton); Ipswich, September 15, 1901 (Bryant); Newton, October 17, 1904 (Bryant). Topfield, October 29, 1926 (Bryant); Readville, June 25, 1904 (Bryant); Allston, April 21, 1906 (Bryant); Blue Hills (Barrows); Brookline, Sharon (Bryant, 1908). Connecticut: (cited by Emerton, 1889). New York: upper Cayuga Lake basin—Fall Creek, Cascadilla Creek, Six-mile Creek (Banks, 1892); Wilmington Notch, August; Lake Bluff, September; Otto, August; Olcott, September; Richbury, September; Rock City, September; Ithaca, May-June, August; Slaterville, August; McLean, April; Deruyter Lake, June; Dormansville, June; French Mills, Albany County, March; Vrooman's Nose, May; Juanita Island, July; Pine Island, May; Baiting Hollow. L. I., April (Crosby and Bishop, 1928); Bergen Beach, April 12, 1908 (von Krockow); Freeville; Sea Cliff (Banks); Alexandria Bay, Buck Island, June (Creighton); Long Island (Banks, 1895); Onondaga County (Britcher). New Jersey: Ramsey, December 1, 1921 (Emerton). Pennsylvania: (Petrunkévitch, 1911). D. C.: (Petrunkévitch, 1911). Virginia: Alexandria (Chamberlin); Falls Church (Banks). North Carolina: Roan Mt. Chapel Hill, Swannanoa Valley (Banks, 1911); Oteen, October 5, 1923; Mt. Pisgah, October 19, 1923; Walnut Creek, Raleigh, October 26, 1923; Bridgewater, October 14, 1923 (Bishop and Crosby, 1926). Kentucky: Bowling Green, September 3, 1928 (Barrows). Florida: Pensacola, January 1-8, 1925 (Barrows). Ohio: Columbus, November 10, 1917; Sugar Grove, December 16, 1915 (Barrows, 1918); Salineville (Banks). Kansas (Chamberlin). Illinois: Chicago (Banks). New Mexico: Las Vegas (Banks). Texas: Brazos County (Banks). Canada: Lake Winnepesaukee (Emerton, 1894). Newfoundland: September, 1912.

Neoantistea gosiuta, new species

Figures 30 and 42

Hahnia radula CHAMBERLIN AND IVIE, 1933, Bull. Univ. of Utah, XXIII, p. 48. (Locality citation; nec *H. radula* Emerton.)

The total length of the male holotype is 2.60 mm., the female allotype, 3.30 mm., and three female paratypes 2.85 mm., 2.90 mm., and 3.25 mm., respectively.

The integument of the cephalothorax is dark, shining, reddish brown. The sternum and labium are concolorous with the carapace, but the endites, coxae, and legs are much lighter, dirty white to yellow. The legs of three of the females are unmarked, but the male and a single female have indistinct annulae on all the joints except the patellae and tarsi. The abdomen is marked as in *agilis*.

The male holotype is taken as a basis for the following measurements.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.07	.27	.62	.15	.28	1.75 mm.
Width	.93	.56	.75	.25	.25	1.15 mm.

The smooth, shining cephalothorax is provided with several spines on the midline and a few on the clypeal margin. The carapace is slightly longer than broad as in the other species and has the pars cephalica distinctly higher but poorly differentiated from the thoracic portion, the sutures being slight and inconspicuous. The clypeus is equal in height to the diameter of an anterior lateral eye. On the lower margin of the furrow of the chelicerae are three small subequal denticles as in *N. agilis*. At the base of the claw on each side is a long feathery hair. The endites are modified, the distal outer margin being tuberculate, but this modification is in a much less degree than in *Neoantistea barrowsi*, *riparia*, and *radula*. The broader than long sternum and labium are clothed with a few hairs on the margins.

The first row of eyes is slightly shorter than the second (13/14), strongly procurved as seen from in front, and the eyes are about equidistantly spaced. Ratio of the eyes: ALE: AME: PLE: PME=8:6:5:5. The posterior median eyes are scarcely twice as far apart as their distance from the laterals (7/4). The median ocular quadrangle is narrower in front (78/83) and about as broad as long (83/88), the anterior medians much larger.

Leg formula, 4123. The legs are armed with the customary bristles as in the other species.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	.90	.40	.67	.65	.42	3.04 mm.
II	.82	.37	.65	.65	.42	2.91 mm.
III	.75	.30	.57	.65	.40	2.67 mm.
IV	1.00	.32	.77	.90	.52	3.51 mm.
Palp	.45	.25	.17		.42	1.29 mm.

Width of patella I, .162 mm. Tibial index, 15.

Width of patella IV, .137 mm. Tibial index, 12.

The spiracle is situated much nearer the genital furrow than the spinnerets (1/2). The spinnerets are placed as in *agilis*, the distal joint of the laterals equal in length to the basal joint.

MALE PALPUS.—This species is closely related to *N. agilis* in male genital characters. The bulb is subovate, and the loop of the seminal duct runs about parallel to

the long axis of the joint. The patellar spur is a short spine about half as long as the tibial apophysis, which is curved sharply caudad. In lateral view this species has considerable resemblance to Keyserling's figure of *riparia*, which was described from Utah. The patellar spur, however, is a spine, not a small tubercle, a character of considerable import in this genus, and unless another closely related form is involved, it seems certain that *N. riparia* (Keyserling) has been correctly identified. The species also differ considerably in size.

The following measurements are for the female allotype.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1 37	.32	.75	.20	.35	2.10 mm.
Width	1 20	.70	.87	.27	30	1 65 mm.

The female agrees well with the male in all important characteristics. The lower margin of the furrow of the chelicerae of the allotype has only two teeth, but in the paratypes three are present. The spiracle is twice as far from the base of the median spinnerets as to the genital furrow ($1\frac{1}{2} \times$). The epigynum is near the conventional type, the openings being close together and the intermediate canal a slender black tube.

TYPE LOCALITY.—Male holotype from east of Yost, Utah, September 6, 1932, "from under rocks" (Ivie), female allotype and paratypes from the South Fork of the Raft River, eight miles south of Lynn, Utah, taken on the same date by Mr. Ivie. The types are in the collection of the University of Utah, the paratypes in the collection of The American Museum of Natural History.

Neoantistea riparia (Keyserling)

Figures 13, 14, 15, 16, 17, 38, 39 and 40

Hahniriparia KEYSERLING, 1887, Verh. k. k. zool.-bot., Gesell., Wien, XXXVII, pp. 463-464, Pl. VI, fig. 27. MARX, 1890, p. 517. BANKS, 1910, p. 15.

Hahnia magna KEYSERLING, 1887, Verh. k. k. zool.-bot., Gesell., Wien, XXXVII, pp. 464-465, Pl. VI, fig. 28. MARX, 1890, p. 517. BANKS, 1910, p. 15. PETRUNKEVITCH, 1911, p. 534. WORLEY and PICKWELL, 1927, p. 67. WORLEY, 1932, p. 52.

Antistea riparia SIMON, 1898, 'Histoire Naturelle des Araignees,' II, p. 529.

A male from Montpelier, Idaho, measures 4.00 mm. in total length, but two females from the same collection are smaller, 3.66 mm. and 3.50 mm., respectively. A female from Seba, Alberta, measures 4.12 mm.

The integument of the carapace is light brown in the few specimens at hand, the cephalic and thoracic striae well marked in black, the margin with a narrow black line. All eyes except the posterior medians are in a dark field. The sternum and endites are light to dark brown, darker than the coxae. In the male the first leg is not marked, but the others show definite traces of black annulae at the base and near the distal ends of all joints but the patellae and coxae, which have a single ring. In the female all the legs are distinctly annulate. The pattern of the abdomen is the same as in *Neoantistea agilis* (Keyserling).

The structural measurements of the male are as follows.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1 75	37	1.00	.30	.55	2.62 mm.
Width	1 61	.97	1 22	38	.50	2 00 mm.

The smooth, shining cephalothorax is provided with a few stout hairs on the clypeus, in the eye area and on the midline near the median suture above. The somewhat longer than broad carapace has the sides broadly rounded, is truncated behind, and has the truncate cephalic portion delimited from the thoracic by a very weak constriction. The pars cephalica is about half as broad as the greatest width of the carapace, is highest just behind the eye group, strongly convex and considerably higher than the slightly convex pars thoracica. The well-marked median suture begins two-thirds of the distance back. The clypeus is vertical, equal in height to the diameter of an anterior lateral eye.

The first row of eyes is slightly narrower than the second in the ratio 83:86, strongly procurved, the eyes nearly equidistantly spaced. The second row is less procurved and has the medians farther apart than their distance from the laterals (20/13). Ratio of the eyes: ALE: AME: PLE: PME=20: 23: 19: 16. The median ocular quadrangle is slightly longer than broad (53/50), is narrower in front (44/50), the anterior median eyes much larger. The posterior median eyes are separated from the anterior medians by scarcely a diameter of the former.

The chelicerae are twice as long as broad, subparallel, and are armed on the upper margin with two unequal teeth, followed by a dentate carina on the inner side, the lower margin with a single large tooth. The slightly broader than long labium is a little more than half as long as the endites, which are coarsely granulate throughout, provided with a band of hairs at the distal inner side and three or four stout tubercles on the distal outer side. These characteristic tubercles and the smaller granules are the bases from which project stout hairs. The sternum is decidedly broader than long, clothed sparsely with hairs that are longest on the margins, is broadest at the second coxae, and weakly truncate between the last coxae, separating them by nearly their length.

Leg formula, 4213. The second pair of legs in the only male specimen in our collection is slightly longer than the first.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.65	.85	1.30	1.20	.70	5.70 mm.
II	1.67	.85	1.30	1.20	.75	5.77 mm.
III	1.30	.57	1.00	1.15	.70	4.72 mm.
IV	1.75	.62	1.30	1.40	.80	5.87 mm.
Palp	.75	.37	.25		.70	2.07 mm.

Ratio of coxae I: II: III: IV = 32: 31: 23: 23.

Width of patella I, .275 mm. Tibial index, 12.

Width of patella IV, .200 mm. Tibial index, 10.

The femora of the first two pairs of legs are strongly incrassate at the base above. Beneath all the joints of these two pairs are two rows of strong tubercles and smaller scattered granules from which originate strong, recurved, spiny hairs. The other pairs are well clothed with hairs and very weak spines.

The abdomen is three-fourths as broad as long, oval, well rounded in front and

behind. The spiracle is much nearer the genital furrow than the spinnerets, the measurements being .40 mm. and 1.07 mm. The spinnerets are arranged as in *agilis*. The terminal joint of the lateral spinnerets is slightly longer than the basal (.45 mm./ .43 mm.) The basal joints of the second and median pairs measure .37 mm. and .30 mm., respectively, the distal joint lacking in the median and greatly reduced in the second pair.

MALE PALPUS.—The differences between this palpus and that of *agilis* are not considerable. The femur is about as long as the tarsus, and either of these a little longer than the patella and tibia taken together. The spur on the patella is greatly reduced. The tibia is proportionately slightly longer than in *agilis* and has an outer spur that is directed nearly at a right angle from the joint. The cymbium is longer than broad, shallowly hollowed out, enclosing the circular bulbal apparatus. The seminal tube is quite broad, and the loop is parallel to the long axis of the joint, not oblique as in *agilis*. The circular embolus, which originates on the prolateral side near the base, circles the bulb and comes to rest on the cymbium near the outer tibial spur.

FEMALE.—A specimen from Montpelier, Idaho, measures 3.66 mm. and serves as the basis for the following measurements.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.45	.32	.80	.21	.30	2.25 mm.
Width	1.22	.75	.90	.30	.30	1.70 mm.

The female is in full agreement with the male in significant structural features. The lower margin of the furrow of the chelicera is armed with three subequal teeth, the upper with two unequal teeth.

The eyes of the first row are slightly narrower than the second in the ratio 71: 74, strongly procurved, equidistantly spaced about one-fourth of a diameter apart. The second row of eyes is less procurved, the medians farther apart than their distance from the laterals (16/11). Ratio of the eyes: ALE: AME: PLE: PME = 18: 17: 13: 13. The median ocular quadrangle is as long as wide, very slightly narrowed in front (38/40), the anteriors considerably larger. The clypeus is as high as the diameter of an anterior lateral eye.

Leg formula, 4123. The legs are weakly spined, the first two pairs slightly in-crasate basally.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.00	.47	.82	.78	.52	3.59 mm.
II	1.00	.47	.78	.78	.55	3.58 mm.
III	.92	.42	.70	.80	.55	3.39 mm.
IV	1.15	.45	1.00	1.07	.65	4.32 mm.
Palp	.46	.22	.32		.52	1.52 mm.

Ratio to coxae I: II: III: IV = 19: 19: 17: 18.

Width of patella I, .162 mm. Tibial index, 12.

Width of patella IV, .137 mm. Tibial index, 10.

The spiracle is situated much nearer the genital opening than the spinnerets, the measurements being .35 mm. and 62 mm. The basal joints of the lateral, second and median spinnerets are .30 mm., .26 mm., and .22 mm., respectively, the distal joint of the lateral one longer than the basal, .35 mm., the distal joint of the second spinneret very short.

EPIGYNUM.—The genital structure of the female is four-sevenths as wide as the sternum and about as long as broad. The thin sclerotic covering is transparent and the epigynal units are clearly visible. The atriobursal orifices are separated by about their diameter and open into a much expanded bursa copulatrix. The intermediate canals are much larger than in *agilis* and are not greatly coiled, joining the expanded receptacula after one turn. Small fertilization canals conduct the semen to the genital furrow and are visible as small dark tubes. The ventral aspect of the epigynum shows the two oval receptacula, and between them the two intermediate canals, which are about as broad as the receptacula.

DISTRIBUTION.—Utah: Spring Lake (type locality of *riparia*, Keyserling, 1887). Wyoming: Fort Bridger (type locality of *magna*, Keyserling, 1887). Idaho: Montpelier, August 16, 1931; Nounan, August, 1931 (Gertsch). Washington: Pullman, Olympia (Banks collection); Palouse, August 28, 1932 (Hatch); Spokane, August 25, 1928 (Hatch). California: Claremont (Banks collection). Canada: Alberta-Seba, June 3–July 6.

***Neoantistea riparia* race *radula* (Emerton)**

Figure 18

Hahnia radula EMERTON, 1889, Trans. Connecticut Acad. Arts and Sci., VII, p. 32, Pl. VII, figs. 10 and 19a. MARX, 1890, p. 517. BANKS, 1892, p. 27. BRYANT, 1908, p. 78. BANKS, 1910, p. 15. PETRUNKEVITCH, 1911, p. 529.

Two males from Tennessee measure 2.70 mm. and 3.25 mm., and three females from the same locality are 3.00 mm., 2.60 mm., and 2.75 mm. in total length. A female from Urbana, Illinois, is 3.75 mm. long.

There seems little doubt as to the conspecificity of eastern specimens with Great Basin material, and yet the constant differences in the eye-group relations would seem sufficient to warrant the retention of Emerton's name as a racial category. Generally speaking, a variation in size is interesting but of no great importance. On the basis of the sparse western material at hand it appears that the average size is greater, but such differences may be matched from other localities. In the genitalia, structure of the legs, shape of the sternum, the position of the spiracle, and in most characters there is complete agreement in specimens from both regions. While it is true that the eyes are extremely variable, such differences occur within definite limits.

Ratio of the eyes of a male from Tennessee: ALE:AME:PLE:PME=18:16:18:18. The median quadrangle is broader than long (44/40) and narrower in front (37/44), the anterior medians slightly smaller in size. Eyes of the second row equal in size, the medians farther apart than their distance from the laterals (11/7). Ratio of eyes of a female from Tennessee: ALE:AME:PLE:PME=19:16:16:17. Median quadrangle as broad as long, narrower in front (22/32), the anterior median eyes slightly smaller. Specimens of *radula* from New England have the eyes of the median quadrangle subequal.

DISTRIBUTION.—Maine: Bayville (Bryant, 1908). New Hampshire: Jaffrey, August 1 (type locality of *radula*, Emerton, 1889); Randolph, July, 1926 (Emerton and Banks); Moosilauke, July 8, 1912. Massa

chusetts: Blue Hills (Barrows); Mt. Greylock (Miner); Tyngsboro, July, 1909 (Emerton); Brookline, October 17, 1904 (Bryant); Gloucester, November 3, 1908; Clarendon Hills, November 3, 1904 (Bryant). New York: upper Cayuga Lake basin (Banks, 1892); Ithaca (Banks); Penn Yan; Cold Spring Harbor, Long Island, April 8, 1905 (Bryant). New Jersey: Ramsey, June 12, 1912 (Emerton). Virginia: Smugglers Notch Mt., Mansfield, July 10, 1908. North Carolina: Newfoundland Gap, August 30, 1930 (Banks). Tennessee: sides of Mount Leconte, September 9, 1928 (Barrows); idem, July 12, 1933 (Gertsch and Ivie). Illinois: Urbana. Michigan: Isle Royale (hermaphrodite). Canada: southern Labrador, July, 1915 (C. W. Townsend); Lake Winnipegosis, 1888 (D. B. Dowling); Kapuskasing, Ontario, June (P. A. Javerner); Moose River Islands, James Bay, June 28, 1920, latitude 51°.

Neocantistea barrowsi, new species

Figures 36 and 37

A male from North Carolina measures 4.25 mm. in total length; a female from Kentucky is slightly smaller, 3.65 mm.

The color pattern of this species is in complete agreement with that of *riparia* and *agilis*. The male has the carapace nearly black, devoid of hairs or spines as in the other species. The carapace of the female is light brown. The legs of both sexes are indistinctly annulate in black, and the side spinnerets have a conspicuous ring at the distal end of the basal joint. The measurements of the male follow.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	2 10	.45	1 25	.30	.62	2.42 mm.
Width	1 95	1 00	1 50	.42	.62	1.90 mm.

The clypeus is provided with long spines. The slightly longer than broad carapace has the thoracic part nearly round, the broad cephalic portion considerably higher and slightly rounded in front and marked off from the pars thoracica by a very weak suture. The well-marked median suture begins two-thirds of the distance back from the front margin. The nearly vertical clypeus is equal in height to the diameter of an anterior lateral eye.

The first row of eyes is slightly narrower than the second in the ratio 12:13, strongly procurved, equidistantly spaced. The second row is less procurved and has the medians farther apart than their distance from the laterals (3/2). Ratio of the eyes: ALE:AME:PLE:PME=22:28:18:17. The median ocular quadrangle is broader than long (6/5.7), slightly narrower in front in the same ratio. The posterior median eyes are separated from the anterior medians by a diameter of the former.

The chelicerae are armed on the lower margin with a single large tooth, the upper with three of which the median is much larger. The sternum, labium, and endites are as in *N. riparia*, the latter with the armature of tubercles and granules even more highly developed than in that species. The legs agree well in stoutness and spining with those of *riparia*. Leg formula, 2143.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	2.25	1.00	1.80	1.70	.95	7.70 mm.
II	2.32	1.00	1.92	1.87	1.00	8.11 mm.
III	1.74	.67	1.32	1.50	.87	6.10 mm.
IV	2.75	.67	1.70	1.92	1.10	7.64 mm.
Palp	.92	.42	.32		.75	2.41 mm.

Ratio of coxae I: II: III: IV = 38: 38: 25: 28.

Width of patella I, .42 mm. Tibial index, 15.

Width of patella IV, .20 mm. Tibial index, 8.

The oval abdomen is three-fourths as long as broad. The spiracle is located much nearer the genital furrow than the spinnerets, the measurements being .375 mm. and .92 mm., respectively. The spinnerets are arranged as in *agilis*, but the lateral one (basal joint .75 mm., distal joint .69 mm. long) is much more robust than the second one, the basal joint of which is .50 mm. long. The middle spinneret (.42 mm. long) is decidedly shorter than the basal joint of the lateral pair.

MALE PALPUS.—The femur, which is provided with a strong tuberculate carina on the lower side, is longer than the tarsus or the patella and tibia taken together. The patella is twice as long as broad and has a small spur at the base on the retro-lateral side. The tibia is longer than broad and is armed at the distal retrolateral margin with a bladeliike, black apophysis, decidedly broader than in *riparia* or *agilis*. In other particulars, except the tibial apophysis, the species closely approximates *N. riparia* (Keyserling).

The following measurements are for the female.

	CARAPACE	FRONT	STERNUM	LABIUM	ENDITE	ABDOMEN
Length	1.75	.42	1.02	.22	.45	2.15 mm.
Width	1.65	.90	1.15	.32	.45	1.75 mm.

Ratio of the eyes: ALE: AME: PLE: PME = 18: 25: 16: 15. The median ocular quadrangle is as broad as long, the posterior median eyes separated from each other by more than a diameter (15/22), about a diameter from the posterior laterals and the anterior medians. The lower margin of the cheliceral furrow is armed with three subequal teeth, the upper with three, of which the middle one is larger. The spinnerets in both sexes of this species are very long, the lateral one slightly longer than the length of the sternum, and its distal joint slightly longer than the basal (.57 mm./ .50 mm.). The second spinneret has the basal joint somewhat shorter (.42 mm.) but longer than the middle spinneret (.36 mm.).

Leg formula, 4123.

	FEMUR	PATELLA	TIBIA	METATARSUS	TARSUS	TOTAL
I	1.40	.60	1.10	1.05	.70	4.85 mm.
II	1.40	.52	1.07	1.05	.70	4.74 mm.
III	1.20	.50	.95	.95	.67	4.27 mm.
IV	1.50	.55	1.32	.142	.87	5.66 mm.
Palp	.67	.25	.40		.67	1.99 mm.

Width of patella I, .20 mm. Tibial index, 11.

Width of patella IV, .16 mm. Tibial index, 8.

TYPE LOCALITY.—Male holotype from Franklinton, North Carolina, August 21, 1933, taken by Mr. Wilton Ivie "in a field under a small

board," the specimen deposited in the collection of the University of Utah. Female allotype from Bowling Green, Kentucky, September 3, 1927, kindly given to the American Museum by Dr. William M. Barrows, of Ohio State University, who collected the species.

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BATS FROM THE PACIFIC ISLANDS. INCLUDING A NEW FRUIT BAT FROM GUAM

By G. H. H. TATE

Since Sanborn¹ published his paper on Pacific Island bats, a number of additional specimens of Chiroptera have been received at the American Museum, chiefly from the Whitney South Sea Expedition. The present paper deals only with those from deep-sea islands outside the New Guinea-Solomon Islands area. The latter region will be handled separately.

Although the collections now to be reported upon comprise only a few more than thirty specimens, they include two specimens of an apparently new species.

Pteropus ualanus Peters

Pteropus ualanus PETERS, 1883, Sitzungsber. Ges. Naturf. Freunde, p. 1.

Caroline Islands (east): Kusaie (= Ualan) Island (A. M. N. H. Nos. 87181-87184), 3 males, 1 female. Nos. 87181-87182 without skulls.

Pteropus mariannus Desmarest

Pteropus mariannus DESMAREST, 1822, 'Mammalogie ou Description des Espèces de Mammifères,' II, Suppl., p. 547.

Marianne Islands: Guam (A. M. N. H. Nos. 87113-87116, 87119), 1 male, 4 females. No. 87119 without skull.

Pteropus pelewensis K. Andersen

Pteropus pelewensis K. ANDERSEN, 1908, Ann. Mag. Nat. Hist., (8) II, p. 364.

Caroline Islands (west): Pelew (= Palau) Island (A. M. N. H. Nos. 87204-87209), two males, 4 females.

Pteropus molossinus Temminck

Pteropus molossinus TEMMINCK, 1853, 'Esquisses Zool.,' p. 62.

Caroline Islands: Ponape (A. M. N. H. Nos. 87166-87180), 7 males, 8 females.

Pteropus tokudae, new species

TYPE.—No. 87117, Amer. Mus. Nat. Hist.; ♂ ad.; Guam, Marianne Islands; August 10, 1931; collector, W. F. Coultas; Whitney South Sea Expedition. Skin and skull in good condition.

¹Sanborn, C. C. 1931, 'Bats from Polynesia, Melanesia, and Maylasia,' Field Mus. Nat. Hist., Zool. Ser., XVIII, No. 2, pp. 7-29.

GENERAL CHARACTERS.—The shortened rostrum, unreduced i_1 , and broad canine cingulum combine to place *tokudae* in the *pselaphon* group. Its small size and naked tibia ally it with *insularis* and *phaeocephalus*.

DESCRIPTION.—Length of pelage of back 9–11 mm., of mantle 12–14 mm., of belly 9–11 mm. Tibia nearly naked. Color of back near mummy brown, lightening to Vandyke brown posteriorly, and almost lacking the sprinkling of whitish hairs to be noted in *molossinus*. Mantle near Mars brown, becoming paler anteriorly and merging with the mottled bistre and gray of the head. Sides of mantle near russet. Sides of neck cinnamon buff, the modified hairs of the neck tufts warm buff. Color beneath mummy brown in abdominal region paling through Prout's brown on the chest to cinnamon buff on the neck, and darkening again to mummy brown on throat and chin.

Ears prominent, with tips rounded. (For comparison, those of *P. molossinus* are short, partly hidden in the fur, and have the tips rather acutely pointed.)

Skull with shortened rostrum and "heavy" (Andersen, pp. 68–69) type of dentition. Coronoid sloping as in *molossinus*. Contrasted with *molossinus*, the following distinctions stand out.

	<i>tokudae</i>	<i>molossinus</i>
Basal flexure of skull	Moderate	Pronounced
Zygomata	Moderately broadened	Widely flaring posteriorly
Upper canines	Short; evenly rounded on outer face; with large basal cingulum	Very long; with longitudinal ridge on outer face; cingulum small, but base of canine very wide anteroposteriorly

MEASUREMENTS

Pteropus tokudae from Guam, compared with measurements of *P. insularis* (from Andersen, 1912)

	No. 87117 ♂ type mm.	No. 87118 ♂ paratype mm.	<i>insularis</i> (from Andersen) mm..
Forearm	....	95	101–109
Zygomatic breadth	23.2	23.4	25.5–26
Width across canines	9.2	8.7	11–11.5
Orbital diameter	8.1	8.3	9–9.3
Mandibular length	30.4	29.5	34.8–35
C–m ²	13.9	13.6	15.8–16
C–m ₃	15.4	14.6	17.7–18
Length p ⁴	2.2	2.3	2.8–3
“ m ¹	2.8	2.8	3.3–3.7
“ m ²	1.2	1.2	1.7–1.9
“ m ₁	2.2	2.6	3.0–3.2
“ m ₂	1.9	1.8	2.2–2.6
“ m ₃	1.1	0.8	1.2–1.7

Pteropus tokudae is based upon two males, the type and a second specimen collected the same day. Its affinities appear to be with *P. insularis* from Ruck and Uala, from which it is distinguished chiefly by its consistently smaller size. It may well be merely a race of *insularis*.

I take pleasure in naming this bat for Dr. M. Tokuda of the Kyoto Imperial University, who is at present engaged in work upon the mammals of the South Sea Islands.

***Emballonura sulcata* Miller**

Emballonura sulcata MILLER, 1911, Proc. Biol. Soc. Washington, XXIV, pp. 161-162.

Caroline Islands: Ponape (A. M. N. H. No. 87188), 1 male.

Amer. Mus. No. 87188 ♂	Forearm	49.5
	Greatest length of skull	16.1
	Condylobasal length	15.0
	Zygomatic breadth	9.8
	Postorbital constriction	2.9
	Breadth of brain case	7.3
	Mandible	12.2
	Maxillary tooththrow (excl. incisors)	5.0

It will be seen that the above measurements, except that of the forearm, are rather less than those given by Miller for *sulcata*. Particularly, our specimen agrees with Miller's in possessing the definite sulcus from nares to sagittal crest completely separating the inflated lateral areas.

Ponape is distant from the Truk group (type locality of *sulcata*) about six and one-half degrees of longitude, but other islands intervene.

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BIRDS COLLECTED DURING THE WHITNEY SOUTH SEA EXPEDITION. XXIX¹

NOTES ON THE GENUS *PETROICA*

BY ERNST MAYR

The present paper contains a continuation of the revisions of Polynesian genera. New investigations were undertaken to clarify the occurrence of unusual immature and adult plumages.

PETROICA Swainson

Petroica SWAINSON, 1829, Zool. Illustr., (2) I, p. 39. Type (by monotypy): *Muscicapa multicolor* Gmelin.

GENERIC CHARACTERS.—Small and medium-sized flycatchers with a relatively small bill which at the nostrils is about as wide as high; tarsi rather weak; wing and tail short; plumage soft and fluffy; adult males usually brightly colored.

This genus lives, with several species or subgenera, in Australia, Tasmania, and New Zealand. Only one species, *Petroica multicolor* (Gmelin), reaches the Polynesian region.² This species appears to be absent on New Caledonia but otherwise has the typical distribution of an Australo-Polynesian species. It has several races on the Australian continent and the neighboring islands (Kangaroo Island and Tasmania), but it also reaches far into Polynesia. The geographical variation of size and coloration is surprisingly small in this vast area and is easily surpassed by the individual variation of plumages.

The correct interpretation of these plumages is the greatest problem in this species, and although I believe I have succeeded in bringing some light into this matter, there still remain some unsolved questions.

Petroica multicolor

RANGE.—Eastern and southern Australia, Kangaroo Island, Tasmania, Norfolk Island, New Hebrides, Banks Islands, Fiji Islands, Samoa, and Solomon Islands.

¹Previous papers in this series comprise American Museum Novitates, Nos. 115, 124, 149, 322, 337, 350, 356, 364, 365, 370, 419, 469, 486, 488, 489, 502, 504, 516, 520, 522, 531, 590, 609, 628, 651, 665, 666, and 709.

²For a map see: Mitt. Zool. Mus. Berlin, XIX (1933), p. 313.

***Petroica multicolor multicolor* (Gmelin)**

Muscicapa multicolor GMELIN,¹ 1789, 'Syst. Nat.,' I, part 2, p. 944, Norfolk Island.

ADULT MALE.—Upper throat and head black, except for a large white spot on the forehead and anterior part of the crown; back, scapulars, rump, and upper tail-coverts black; lower throat, breast, and abdomen reddish scarlet; crissum and under tail-coverts white, thighs black; tail entirely black, the outer tail-feathers with light edges; wing black, inner middle and greater upper wing-coverts white or partly white; axillaries and some of the under wing-coverts whitish; inconspicuous white band across the inner webs of the secondaries.

Iris brown, bill and feet black.

IMMATURE MALE (first-year plumage):

PHASE *a*.—Upper side dull cinnamon-brown, in some specimens distinctly washed with rufous, in others more olivaceous or grayish; forehead slightly lighter; sides of head mottled buffy, brownish and grayish; circumocular feathers buff; chin and upper throat whitish; wing brown, edges of upper wing-coverts ochraceous buff; ochraceous tawny bar across the outer webs of the secondaries and inner primaries; buffy white bar across the under side of the wing much broader and more conspicuous than in the adult; tail dark brown, tail-feathers with light brown edges; outermost tail-feather with considerable white on the outer web and on the tip: lower throat, breast, and upper abdomen scarlet, strongly mixed with cinnamonaceous on the breast, sides of breast and flanks.

PHASE *b*.—Similar to phase *a*, but under side orange scarlet, instead of scarlet.

PHASE *c*.—Similar to phase *a*, but under side light cadmium yellow, instead of orange or scarlet.

PHASE *d*.—Similar to phase *a*, but under side without any lipochromes; breast and sides washed with grayish cinnamon.

There are in the Whitney collection two specimens of phase *a*, two of phase *b*, three of phase *c*, and one of phase *d*.

ADULT FEMALE.—Very similar to phase *b* of the immature males, but with much less lipochrome on the under side.

IMMATURE FEMALE.—Similar to the adult female, but with still less lipochrome.

Tarsus, 22–23.5 (23.0); culmen, 15.5–17.0 (16.1) (in adult males).

	WING	TAIL
4 ♂ ad.	69–70 (69.8)	52 (52.0)
8 ♂ imm.	65–69 (66.6)	48–52 (50.1)
3 ♀	67–69 (67.8)	50–51 (50.6)

RANGE.—Norfolk Island, Australian Sea.

The Norfolk Island bird is in many respects a very distinct subspecies. Its bill is long, slender, and laterally compressed, while the other forms of the species have a more typical flycatcher bill. Compared with the other oceanic subspecies it differs in the large size of the frontal white patch, in the almost complete absence of white on wing and tail, and in the wide extent of the scarlet area on the under surface.

¹For synonyms see Mathews, 1930, 'Syst. Av. Austr.,' p. 446.

I have treated in detail the various color phases of the immature male since they seem to cast some light on the relationship of the yellow, orange, and red pigment. It confirms the idea of their close relationship already held for some time by the biochemists and the more progressive taxonomists.

The material is not sufficiently extensive to decide with absolute certainty whether or not all of the eight immature males are in exactly the same plumage. There is a possibility that one or two are in a retarded adult plumage, but only in one bird (phase *a*) are the testes indicated as large. However, this bird has the skull not yet ossified, and therefore I doubt the correctness of the indication on the label.

Petroica multicolor pusilla Peale

Petroica pusilla PEALE, 1848, 'U. S. Explor. Exped.,' Birds, p. 93, Pl. xxv, fig. 3, Upolu, Samoa Islands.

ADULT MALE.—Crown, back, scapulars, rump, upper tail-coverts, sides of head, lores, ear-coverts, and upper throat (sooty) black; large patch on forehead white; wing-feathers and tail-feathers brownish black; median upper wing-coverts and inner greater coverts white with black bases, some of the secondaries (fourth to sixth) with narrow white or buffy edges; seventh to ninth primary with small white spot on the outer web near the base; white bar across inner web of secondaries and inner primaries; outermost (sixth) pair of tail-feathers buffy with blackish brown area on the base extending along the inner web, and a similar area in the lower third of the outer web; fifth and fourth pair also with more or less extended areas of buffy white; axillaries and part of under wing-coverts white, lesser under wing-coverts blackish; lower throat, breast, and upper belly pale vermillion to pale scarlet; lower flanks, lower belly, and under tail-coverts white or buffy white; thighs blackish.

Iris brown, bill black, feet brown.

IMMATURE MALE (first-year plumage).—Similar to the adult male, but retains tail and wing of the nestling plumage, except the tertials and some of the inner upper wing-coverts.

NESTLING MALE.—Upper side smoky brown, feathers on the crown with buffy shaft-streaks, and on the back and rump sometimes more sooty; feathers of throat and breast with gray bases, light centers, and blackish or brownish edges; abdomen whitish or pale ochraceous; wing blackish brown, upper wing-coverts and secondaries with ochraceous tips; white bar across the outside of the wing scarcely developed; tail blackish brown and buffy, pattern about as in adult birds.

ADULT FEMALE.—Similar to adult male, but blackish parts more sooty; white patch on forehead and on wing smaller; ochraceous edges on secondaries more pronounced; chin and upper throat mottled grayish, not black; reddish tones on under parts less intense and more restricted to the breast; lower abdomen whitish or buffy, sides of breast often grayish.

IMMATURE FEMALE (first-year plumage).—Similar to the adult female, retains tail and wing of the nestling plumage, except the tertials and some of the inner upper

wing-coverts; usually also less red on the under parts and the white frontal patch smaller.

NESTLING FEMALE.—Very similar to male nestling, but usually lighter, particularly on the under parts.

Tarsus (in adult males), 17–18; culmen, 13.5–14.5 mm.

	WING	TAIL
Upolu ♂ ad.	60–63 (61 1)	37–39 (38 2)
♀ ad.	58–61 (59 2)	36–40 (37 8)
Savaii ♂ ad.	59–63 (61 0)	37–40 (38 8)
♀ ad.	58–61 (59 1)	36–39 (37.7)

RANGE.—Upolu and Savaii, Samoa Islands.

Specimens from Upolu and Savaii agree with each other in every respect. There is, however, a considerable degree of individual variation, particularly in the females. The red of the under side is sometimes more reddish scarlet, sometimes more orange-scarlet; the gray of the throat is sometimes more blackish, sometimes mixed with whitish; the lower belly is sometimes pure white, sometimes with an ochraceous tinge; the same is true for the white marks on wing and tail, which are sometimes pure and in other specimens with a definite ochraceous tinge. These differences are of an individual nature and have no geographical significance.

Some of the females from Savaii have yellowish feet and yellowish-brown mandibles. I do not know whether this has any significance in regard to the age of these specimens, since all their other characters are typically adult.

Petroica multicolor kleinschmidti Finsch

Petroica kleinschmidti FINSCH, 1875, Proc. Zool. Soc. London, p. 643, Viti Levu, Fiji Islands [description of female].

ADULT MALE.—Very similar to *pusilla* Peale, but upper side slightly deeper black, white spot on forehead considerably larger, white bar on under side of wing broader and more extended; white bar across the upper side of the wing usually also more developed; white patch on the wing possibly larger.

ADULT FEMALE.—Entirely different from that of *pusilla*; upper side not sooty black, but dark slate-colored with a brownish wash; forehead lighter, but not white; lores and eye-ring whitish or light gray; upper and middle throat whitish with a buffy, grayish, or pink wash, not dark grayish; breast peach-red, paler and more pinkish, less scarlet than in *pusilla*; extension of reddish zone on under side apparently more restricted; flanks, belly, crissum, and under tail-coverts whitish; wings and tail lighter, less blackish; whitish buff or ochraceous bar across the wing and edges of secondaries broader.

IMMATURE MALE (first-year plumage).—Very variable, but generally similar to the adult female; red on under side more extended; tail and wing from the nestling plumage.

IMMATURE FEMALE (first-year plumage).—Similar to adult female, but with nestling wing and tail; red restricted to middle of breast, sides of breast and flanks washed with brownish gray; mandible and feet yellowish or brown.

NESTLING.—Indistinguishable from that of *pusilla*.

Tarsus (in adult males), 16.5–17.5; culmen, 13–14 mm.

	WING	TAIL
♂	61–65 (61 9)	38–41 (39.7)
♀	59–60 (59 5)	38–39 (38.3)

RANGE.—Viti Levu and Vanua Levu, Fiji Islands.

This subspecies, which is very well marked in the female plumage, has been considered a synonym of *pusilla* by the majority of the authors. There are only a few specimens in collections, and even the Whitney Expedition did not get a complete series. It is therefore not possible to classify with certainty all of the various plumages occurring in this subspecies.

Freshly molted males (May and June) have the under parts pinkish scarlet, while birds from October, December, and January, in a more worn plumage, have a more orange-scarlet coloration. It is however doubtful whether this difference can always be attributed to wear and bleaching. A series from Samoa (see p. 4), collected within one month, also shows considerable variation.

Two of the males wear unusual plumages. One is from Viti Levu (No. 251449, collected in May) and one from Vanua Levu (No. 251445, collected in February). Both have small testes and the skulls apparently not quite ossified. However, they are quite different from typical immature males. They are almost as extensively red underneath as an adult male, but the throat is neither whitish nor black, but of a blackish gray mixed with reddish; the upper side is of a smoky gray, but badly worn; and the white spots on forehead and wing are fully developed; the wing-coverts are without light tips, and the primaries are shaped very much as in an adult bird. It is hard to say whether these are immature birds in a progressive phase, or, which is more likely, adult birds in a retarded plumage.

Petroica multicolor becki, new subspecies

TYPE.—No. 251416, Amer. Mus. Nat. Hist.; ♀ ad., Kandavu Island, Fiji Islands; November 3, 1924; R. H. Beck and J. G. Correia.

ADULT MALE.—Very similar to that of *kleinschmidti*, but red on flanks reaching farther down; middle of throat frequently mixed with reddish; upper side not so deeply black, buffy or whitish edges on the secondaries much narrower.

ADULT FEMALE AND IMMATURE BIRDS.—Similar to specimens of *kleinschmidti* in the equivalent plumage, but having the upper side lighter, and with a warmer,

more cinnamonaceous, less slaty tinge; sides of face and breast also more brownish; edges of upper wing-coverts, secondaries, and bar across the wing more ochraceous, less buffy white; throat, sides of breast, flanks, and sometimes even the crissum distinctly washed with ochraceous, while in *kleinschmidti* these parts are either whitish, grayish, or only faintly tinged with ochraceous; red on under side farther extended on the middle of the throat and down the flanks; the red on the under side is more salmon-red, less pinkish scarlet; this difference however is partly due to the condition of the plumage, most of the Kandavu birds being collected later in the season.

	WING	TAIL
11 ♂ ad.	60-64 (61.7)	38-41 (39.1)
6 ♀ ad.	56-60 (58.5)	38-39 (38.6)

RANGE.—Kandavu Island, Fiji Islands.

While working out the Casey Wood collection from the Fiji Islands, Wetmore remarked on a possible difference between Viti Levu and Kandavu birds (Ibis, 1925, p. 845). He had, however, very insufficient material and refrained therefore from the naming of the Kandavu bird. The series collected by the Whitney South Sea Expedition shows that the difference is not individual and that the Kandavu birds can be separated as a distinct subspecies from the Viti Levu birds. Wetmore's specimens, kindly loaned to me by the U. S. National Museum, fully agree with the Whitney material.

One would expect to find birds from Taviuni Island identical with Vanua Levu Island birds, in analogy with other species of Fijian birds. My material unfortunately is very insufficient, consisting of one adult female and two males in the first year plumage, but these specimens seem to be intermediate between *kleinschmidti* and *becki*, in fact in the coloration of the upper side they more closely resemble *becki*. Additional material must be examined before anything definite can be said about the systematic position of the Taviuni birds.

Petroica multicolor ambrynsensis Sharpe

Petroica ambrynsensis SHARPE, 1900, Ibis, p. 341, Ambryn Island.

ADULT MALE.—Progressive type of plumage; similar to *Petroica multicolor kleinschmidti* and *pusilla*, but bill longer and more narrow; upper parts duller, not quite as pure black: light edges on secondaries very narrow or missing; bar across outer webs of primaries only indicated, or missing; white bar across the under side of the wing narrow and inconspicuous; light pattern on tail and size of white frontal patch extremely variable.

ADULT FEMALE.—Differs from females of *kleinschmidti* and *pusilla* in many ways, but approaches *becki* from Kandavu in some respects. Under side rather extensively red, reaching from the lower throat to the lower abdomen; reddish colors not pinkish, but orange-red or salmon-red; throat, sides, flanks, and sometimes also the crissum washed with ochraceous; throat strongly washed with grayish, thus

darker than in *becki*; upper side similar to that of *becki*, but darker and less sandy colored, however without the pronounced grayish tone of *kleinschmidti*; tips of feathers on forehead very light (ochraceous); white or ochraceous marks on wing, as in male, much less developed than in the Polynesian forms.

IMMATURE MALE (first-year plumage).—Indistinguishable from the adult female, possibly averaging slightly more rufous on the upper parts; under parts extremely variable, but flanks and lower belly averaging more whitish, less ochraceous; wearing a combined plumage, wings and tail belonging to the nestling plumage.

IMMATURE FEMALE (first-year plumage).—Upper parts as in the adult female, but red on under parts less extended and much paler; wings and tail immature.

NESTLING.—Similar to that of *kleinschmidti*, but slightly darker, particularly on the breast; ochraceous band across the wing, and ochraceous edges of secondaries fairly well developed.

Tarsus, 19; culmen, 13.5–14.5 mm.

		WING	TAIL
New Hebrides	3 ♂ ad.	62, 63, 65	41, 41, 45
	1 ♀ ad.	60	40
Gaua Island	7 ♂ ad.	60–63 (61 5)	41–43 (41 6)
	4 ♀ ad.	59–60 (59 8)	40–41 (40 5)

RANGE.—Tongoa, Lopevi, Pauuma, Ambryn, Aoba, and Santo, New Hebrides; Meralav and Gaua Island, Banks Islands.

The original description of this form, based on a single adult and one immature male, is very scanty and does not point out any difference from *similis*. However, Sharpe mentions one character of this form, namely the reduction of the light pattern on the wing.

Petroica multicolor similis Gray

Petroica similis G. R. GRAY, 1859, 'Cat. Birds Trop. Islands Pac.,' p. 15, Aneiteum, New Hebrides.

ADULT MALE.—Similar to *ambrynsensis*, but black of upper side duller, more sooty; white patch on upper wing-coverts larger; throat tending to be not pure black, but mixed with grayish brown; light bar across the outside of the wing sometimes indicated, white band across the under side of the wing slightly wider; size of white frontal patch and extent of red on flanks variable and apparently without geographical significance.

ADULT FEMALE.—Unknown.

Of three "females" in the British Museum, one (from Aneiteum) seems to be immature, and two (from Aneiteum and Tanna) seem to be young males, wrongly sexed, according to the information given to me by Mr. Kinnear. A female from Aneiteum in the Whitney Collection, also appears to be an immature male. I shall give a detailed description of this specimen.

IMMATURE MALE (first-year plumage) ? (No. 212424).—All upper parts dark grayish, with a slight olivaceous, but no rufous tinge; forehead and circumocular feathers whitish; upper tail-coverts very dark, almost sooty; chin white, throat whitish with a gray tinge; breast and upper belly pale orange-scarlet; flanks, cris-

sum and under tail-coverts white; wing fuscous, alula and primary-coverts with soft buffy tips (sign of immaturity); broad white bar across inner five primaries and across the secondaries; some of the secondaries with narrow buffy edges; inner upper wing-coverts (freshly molted) blackish with broad white tips; broad white bar across the under side of the wing; tail with an unusually large amount of white, outermost tail-feather almost completely whitish. Wing, 62; tail, 43; culmen, 14; tarsus, 19 mm.

This bird (collected in June 1926) is sexed as a female, but it seems to be an immature male in the "combined" first-year plumage. More material must be studied before it can be decided whether the unusual amount of white in this bird is abnormal, or a normal character of this subspecies. According to Kinnear (*in litt.*) there is in the British Museum a male from Aneiteum (Freeman collector) "with white throat and whitish cheeks."

RANGE.—Aneiteum, Tanna and Erromango, New Hebrides.

The above described "female" (= ? immature male) is the only specimen of this subspecies which I have examined. All the other data on this subspecies I owe to the information kindly given to me by Mr. Norman B. Kinnear. The British Museum has six birds from Aueiteum, two of which seem to be (? semi-) adult males, three immature males, and one an immature female. Besides these typical birds the British Museum has also one adult and one immature (sexed "female") male from Tanna, and one immature male from Erromango. The adult male from Tanna is the only specimen in the British Museum in which the black of the throat is not suffused with grayish.

The material thus far collected in the three southern New Hebrides is quite insufficient to decide whether or not there are any differences between the birds from the three islands. So long as there is no evidence to the contrary I regard them as identical.

***Petroica multicolor feminina*, new subspecies**

TYPE.—No. 212410, Amer. Mus. Nat. Hist.; ♂ ad.; Mai Island, New Hebrides; July 7, 1926; R. H. Beck and J. G. Correia.

ADULT MALE.—Well-developed white patch on forehead; crown brown with a pronounced vinaceous-red wash; back umber brown, lighter on the rump, and with a rather pronounced reddish-brown spot in the middle of the back; upper tail-coverts darker brown; chin whitish; upper throat whitish, feathers with pink tips; lower throat, breast, and abdomen scarlet, in some specimens darker, in others paler; sides of breast with an olivaceous-brown wash; lower flanks, crissum, and under tail-coverts white or light ochraceous; wing brown, insignificant narrow ochraceous bar across the outer webs of the three or four innermost primaries; upper wing-coverts and secondaries with dark ochraceous or rufous-brown edges; innermost upper wing-coverts occasionally edged with whitish; white bar across the under side of the wing practically obsolete; tail fuscous, with the light pattern reduced to a light area on the outer web of the outermost tail-feather.

Bill brown, base of mandible yellowish; iris and feet brown.

ADULT FEMALE.—Similar to the adult male, but upper side lighter, more cinnamonaceous, not so dark brown; feathers on forehead with buffy or pale ochraceous tips, but without a patch of white feathers; lores mottled whitish; chin and entire throat whitish with a slight grayish-brown and sometimes pinkish wash; extent of scarlet on under side reduced as compared to adult male, not reaching so far up on the throat and so far down on the flanks and belly; wing and tail very much as in the male, but female possibly with somewhat more whitish on the tail.

IMMATURE MALE (first-year plumage).—In coloration almost identical with the adult female, possibly still lighter on the upper side and on the throat; wings and tail immature; these birds are very similar to *P. m. ambryensis* in the same plumage, but lighter and more rufous cinnamon on the upper side.

IMMATURE FEMALE (first-year plumage).—Very similar to immature male, but with the reddish tones reduced; upper side practically without any reddish hue; scarlet on under side reduced to a scarlet-orange band across the breast and upper abdomen.

Culmen (in adult males), 14; tarsus, 19.

	WING	TAIL
6 ♂ ad.	63-66 (64.5)	42-46 (44.0)
5 ♂ I y.	59-63 (61.8)	41-42 (41.2)
5 ♀ ad.	60-63 (61.4)	40-43 (41.2)
4 ♀ I y.	59-61 (60.2)	40-41 (40.5)

RANGE.—Efate and Mai Islands, New Hebrides.

This new form is highly interesting since the adult plumage of the male is a retarded plumage which is very similar to that of the female. We have here a case similar to that in *Pachycephala pectoralis feminina* (see Amer. Mus. Novit., No. 486, pp. 25-27).

Petroica multicolor soror, new subspecies

TYPE.—No. 212229, Amer. Mus. Nat. Hist.; ♂ ad.; Vanua Lava Island, Banks Islands; November 10, 1926; R. H. Beck and J. G. Correia.

ADULT MALE.—Very similar to that of *P. m. feminina*, and with the white patch on the forehead well pronounced, but all upper parts darker, less brownish; sides of head, wings, and tail also darker, and more fuscous, less brownish; scarlet of under side more intense and reaching higher up on the throat, grayish or grayish-brown wash on the upper breast and on the sides less pronounced; pattern on wing and tail very much as in *feminina*; innermost upper wing-coverts always edged with whitish.

ADULT FEMALE AND IMMATURES.—Differ from the equivalent plumages of *feminina* also by being darker and less brownish.

Culmen, 14-15; tarsus, 19.

	WING	TAIL
5 ♂ ad.	64-66 (65.0)	42-44 (43.4)
1 ♀ ad.	62.0	43.0

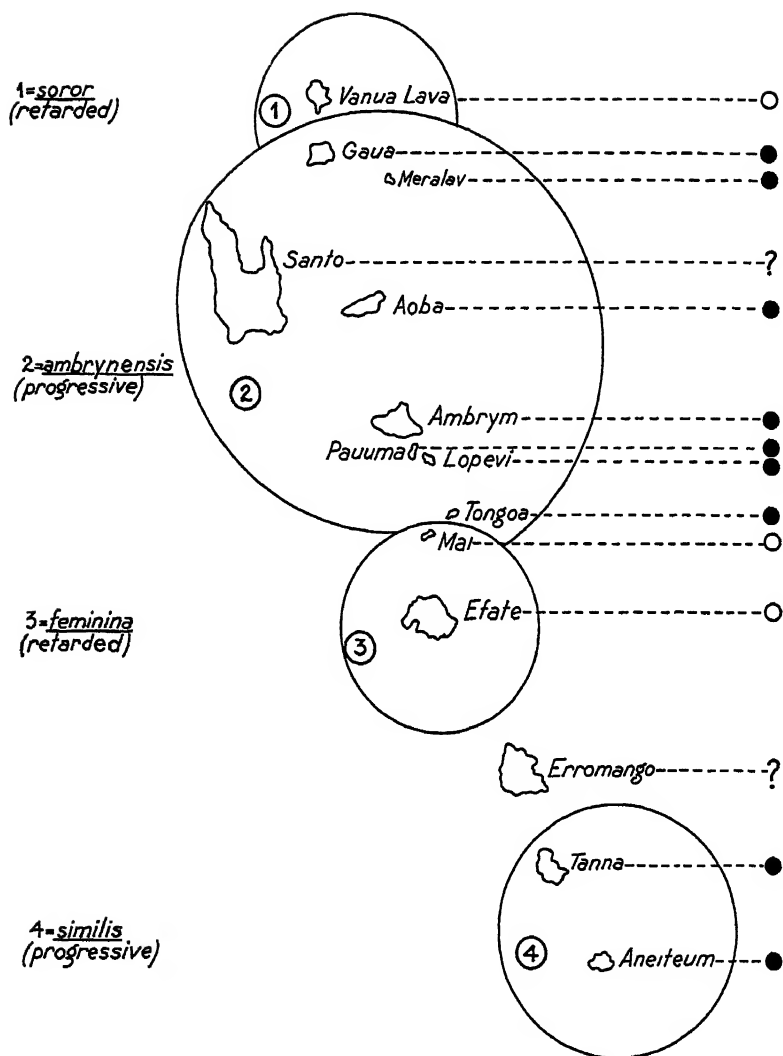


Fig. 1. Geographical distribution of the types of plumage in *Petroica multicolor* on New Hebrides and Banks Islands.

○ = plumage of adult males retarded.

● = plumage of adult males progressive.

RANGE.—Vanua Lava Island, northern Banks Islands.

This subspecies is surprisingly similar to *feminina*, although the ranges of the two forms are widely separated by *ambryensis*, which lives in the northern New Hebrides and southern Banks Islands. Four of the five adult males have the gonads greatly enlarged (in November). Four other males, which I consider as immature on account of pale ochraceous tips of the primary-coverts, have also enlarged testes. There is a possibility that this species begins breeding while still in the first-year plumage.

***Petroica multicolor polymorpha*, new subspecies**

TYPE.—No. 227992, Amer. Mus. Nat. Hist.; ♂ ad.; San Cristobal Island, Solomon Islands; December 13, 1929; E. Mayr, W. F. Coultas, and W. J. Eyerdam.

ADULT MALE (typical plumage).—Similar to *Petroica multicolor kleinschmidti* Finsch, but upper side apparently deeper black; white frontal patch washed with pink, particularly in its posterior portion; white patch on wing appearing larger in the examined specimens, but this probably is due to the different method of preparation; second to fifth secondary with broad white edges on the outer web, while in *kleinschmidti* the same feathers are either entirely black or have only a narrow white or buffy edge; lower flanks and crissum pure white, not with a buffy or ochraceous wash; breast and abdomen light scarlet-red.

ADULT MALE (red-headed phase).—Agrees in the coloration of back, breast, abdomen, wing, and tail with the adult male in the typical plumage, but the head has an entirely different coloration: forehead pale brown; crown brownish, more or less strongly washed with rufous-vinaceous, which sometimes obliterates the brownish tones completely; chin grayish or buffy white, upper throat reddish scarlet, middle of throat blackish, many feathers with reddish tips; lores whitish, sides of head cinnamon with a slight reddish wash.

Besides these typical adult birds in the normal black-headed and the unusual rufous-headed phase, there are a number of abnormal and immature specimens in the collection. Fortunately they were all collected during the molting season, which permits important conclusions on the sequence of plumages, but unfortunately there are no additional collections from any other season, which accounts for the small number of birds in the first year dress.

I have tried to outline a classification of the possible sequence of plumages in this species, but I have to admit frankly that I do not feel sure that I have interpreted correctly all the observed phenomena, particularly since several plumages are represented by only one specimen.

Table of Plumages and Molts of Males of *Petroica multicolor polymorpha*
as Shown by the Specimens Collected by the
Whitney South Sea Expedition

I.—NESTLING PLUMAGES AND SUBSEQUENT MOLTS

Nestlings molting into the "retarded" first-year plumage	227994 ¹
Nestlings molting into the "progressive" first-year plumage	227998 and 227999

II.—FIRST-YEAR PLUMAGES AND SUBSEQUENT MOLTS

	Black-headed phase	Rufous-headed phase
First year retarded molting into adult retarded		227993
First year retarded molting into adult progressive	? 227989	
First year progressive molting into adult progressive	228016 ? 227989	227990

III.—ADULTS PLUMAGES AND SUBSEQUENT MOLTS

	Black-headed phase	Rufous-headed phase
Adult retarded molting into adult retarded	228017	227995
Adult progressive molting into adult progressive		228015
Not molting	228001 228014	227992 227996 227997

There is no evidence in all my material for the following additional possibilities of plumage changes:

- From a progressive first-year plumage to a retarded adult plumage.
- From a retarded adult plumage to a progressive adult plumage.
- From a rufous-headed plumage to a black-headed plumage.

Description of Immature and Unusual Plumages

NESTLING MALE.—Plumage soft, downy; upper side dark cinnamon-brown, feathers with pale (buff) shaft-streaks; upper throat pale ochraceous, lower throat and breast ochraceous tawny; lower belly, flanks, and under tail-coverts whitish; tail blackish brown, outermost pair with white marks, which are more extensive than in adult; wing blackish brown; upper wing-coverts and secondaries with ochraceous-tawny tips or edges; innermost upper wing-coverts sometimes partly whitish; bar across the outer webs of primaries and secondaries white.

From the nestling plumage these birds may molt into a "retarded" or a "progressive" first-year plumage. Unfortunately the collection contains only very few birds in the first-year plumage, and I am not sure whether the descriptions reconstructed from molting specimens are entirely correct.

¹Numbers refer to the catalogue numbers of The American Museum of Natural History.

MALE (retarded first-year plumage).—Wing as in nestling. Upper side and sides of head of a uniform cinnamon brown, lighter on the forehead; chin, throat and lores whitish; breast pinkish or pale salmon-colored, washed with ochraceous, particularly on the sides.

MALE (progressive first-year plumage).—Birds in this plumage apparently have the reddish tones on the under side deeper (approaching scarlet), the back, the wings, and the tail more blackish, and (if they belong to the rufous-headed phase) the crown strongly washed with reddish. It is possible that in some cases even birds of the black-headed phase have a rufous-tinged crown in the first-year plumage (No. 228016).

This first-year plumage is apparently worn almost a full year—namely, until the beginning of the next breeding season.

MALE (black-headed adult plumage).—Most specimens in the collection are in the “progressive” plumage, described above (p. 11). However, there is one unusual bird (No. 228017) that is molting from one retarded plumage into another one. The worn plumage is rather brownish on the sides of the head, and with a distinct reddish wash on the crown; the edges of the secondaries, the light marks on the tail, and the lower belly have a marked ochraceous wash. The new feathers of the upper side are sooty or brownish black, not jet-black, and have whitish bases on the upper throat instead of being entirely black. The old wing-feathers, as well as of course the new, have all the characters of an adult condition.

MALE (rufous-headed adult plumage).—In this phase also the majority of the molting specimens is molting from one progressive plumage into another. However, the special interest afforded by this kind of molt is the fact that the birds do not change over into the black-headed phase. Once rufous-headed they always seem to remain rufous-headed.

One bird (No. 227995) is molting from a retarded plumage again into a retarded plumage. The new feathers on the head are less reddish than in a bird with a “progressive” plumage, they are more reddish brown; the feathers of the back are brownish with a reddish tinge, the upper tail-coverts and the tail blackish brown; the feathers of the throat (also the newly molted ones) are whitish with pink or ochraceous-pink tips; the breast light scarlet and the sides of the breast washed with ochraceous; the wing-feathers seem to acquire a more progressive appearance by the molt; the old wing, although adult as shown by the shape of the first primary and the lack of rufous edges on the primary-coverts, has the secondaries with ochraceous edges and the upper wing-coverts with rufous-ochraceous edges, in the new wing these feathers have whitish edges.

ADULT FEMALE (typical).—Somewhat similar to the adult male in the rufous-headed phase, but all colors less intense. Crown dull rufous brown or cinnamon brown, with a slight reddish wash; forehead lighter, some feathers with pale buffy or whitish edges; lores whitish; ear-coverts and sides of neck dull brownish; back sooty black, rarely as blackish as in an adult male, usually with a liberal admixture of brownish; no sharp line of demarcation between the brownish crown and black back, but rather a slow intergradation; coloration of throat variable, usually chin and upper throat whitish; middle of throat more grayish or with an ochraceous wash, lower throat of the same color as breast and belly; middle throat and sometimes upper throat more or less washed with pink; breast and abdomen pale scarlet or grenadine; crissum,

lower flanks, and under tail-coverts white; wing and tail as in adult males. As in some adult males the white marks in the wing of some of the females in worn plumage have an ochraceous tinge; this is likely due to discoloration since it can not be found on any newly molted feather.

ADULT FEMALE (retarded).—There is one specimen in the collection (No. 228006) which molts from the first-year plumage into an adult plumage. Only the wing is molting, while the body plumage is fresh, apparently having just completed its molt. The back in this bird is not black but (rufous) brown like the crown, but the lower back is somewhat darker; upper and middle throat white with a strong brownish wash. The brownish color of the back and the coloration of the throat cause me to regard this bird as possessing a "retarded" plumage. There are three additional females in the collection (Nos. 227991, 228009, and 228012) which show intermediate characters. The back is only partly brownish, and the brownish wash on the throat is also less pronounced.

FEMALE (first-year plumage).—Very similar to that of the male. Upper side uniform brownish, darker on lower back and rump, more rufous on the crown; sides of head cinnamon; upper and middle throat whitish, with a brownish wash on the sides; lower throat and breast pale salmon-colored; abdomen and under tail-coverts white; wing blackish, secondaries, primary-coverts, and upper wing-coverts with deep ochraceous edges or tips; a white or cinnamonaceous bar across the outer web of the five innermost primaries, a whitish bar across the base of the outer secondaries; tail blackish, most tail-feathers with small white tips; outermost pair with extended white area.

NESTLING FEMALE.—Similar to male nestling, but upper side and wing somewhat lighter and more brownish.

Culmen (in adult males), 14; tarsus, 17-18.

	WING	TAIL
7 ♂ ad.	60-63 (61.4)	39-43 (40.4)
6 ♀ ad.	60 (60.0)	40-41 (40.4)

RANGE.—San Cristobal, Solomon Islands (collected December 1929.)

***Petroica multicolor septentrionalis*, new subspecies**

TYPE.—No. 225221, Amer. Mus. Nat. Hist.; ♀ ad. (ovaries large); Bougainville Island, Solomon Islands; January 19, 1928; F. P. Drowne.

ADULT MALE.—Probably identical with the black-headed phase of *polymorpha*; the only differences seen in my specimens (reduction of pink on forehead, lighter red on under side, duller black of upper parts, ochraceous tinge on wing and crissum, and less conspicuous white on wing) are apparently caused by wear, soiling, and method of preparation. Rufous-headed phase absent.

ADULT FEMALE.—Entirely different from the adult female of *polymorpha*; rather resembling the first-year plumage of that subspecies; but differs from it in having the upper side lighter and more olivaceous cinnamon than rufous brown, in having no white in the wing (except a white bar on the under side of the wing), and in not having throat and abdomen whitish, but washed with grayish buff. The reddish colors on the under side are not restricted to the breast as in first-year birds, but reach from the

throat to the lower belly. Only the crissum and under tail-coverts are without lipochrome.

There is a great deal of individual variation in the coloration of the under side. There is every step represented from a yellow (orange buff, R. 15) to a scarlet, usually these colors are pale and not intense.

One specimen (No. 225222) wears a somewhat "progressive" plumage. The feathers on the forehead and some of the upper wing-coverts have pinkish-white edges, the upper side has a decided rufous wash and the grayish ochre wash of the under side is much reduced.

DESCRIPTION OF THE TYPE (No. 225221).—Crown, hind neck, back, scapulars, and rump cinnamomeous brown (Saccardo's Umber, R. XXXIX), forehead lighter; lores whitish; sides of head sandy cinnamon; upper throat whitish with a pinkish buff wash; lower throat and upper breast ochraceous salmon, more grayish ochre on the sides of the breast; upper belly light salmon-orange, lower belly, under tail-coverts, and flanks whitish with a slight pinkish wash; wings dark brown, upper wing-coverts with cinnamon-brown tips; secondaries with tawny-ochraceous edges, narrow ochraceous-buff bar across the outer webs of the sixth to tenth primaries; broader and somewhat lighter bar across the outer webs of the secondaries, broad white bar across the inner webs of the secondaries and some of the primaries; tail-feathers blackish brown with narrow buffy edges; outermost pair of tail-feathers with buffy white mark of about the same extension as in the male.

FIRST-YEAR PLUMAGE (male and female).—Practically identical with the adult female plumage, differing only in the shape of wing-feathers and tail-feathers, and in the ochraceous margins on the primary-coverts.

NESTLING.—Similar to that of *polymorpha*, but differs in having a lighter and more cinnamomeous upper side, in a more brownish (not blackish brown) wing and tail, and in having the edges of the wing-coverts and the cross bar on the upper side of the wing tawny ochraceous, not partly whitish.

Culmen, (in adult males), 13.5–14; tarsus, 16–17.

	WING	TAIL
11 ♂ ad.	59–61 (59.9)	37–40 (38.8)
5 ♀ ad.	58–59 (58.4)	38–39 (38.4)

RANGE.—Bougainville Island, Solomon Islands.

Some of the adult males wear a plumage that might be regarded as somewhat "retarded." The feathers on the throat have in these specimens grayish bases and only the tips are blackish, the upper parts are not deep black, but sooty black, the feathers on the forehead are mixed with blackish, and the edges of the secondaries and the flanks are washed with ochraceous. Otherwise these specimens show every character of maturity.

One specimen is albinistic (No. 225217). Its chin and upper throat are white, bordered with a black line; there are a number of white or pinkish feathers on the sides of the head, on the crown, and on the hind-neck, and there are also some whitish feathers (one primary-covert and

one secondary) in the left wing. The testes are indicated as "large" on the label.

The individual variation found in the females is very much of the same type as described from *multicolor* (see p. 2), but not quite so pronounced.

***Petroica multicolor kulambangrae*, new subspecies**

TYPE.—No. 219373, Amer. Mus. Nat. Hist.; ♂ imm.; Kulambangra Island, Solomon Islands; October 13, 1927; R. H. Beck.

ADULT MALE.—Apparently indistinguishable from those of *P. m. polymorpha* and *septentrionalis*.

ADULT FEMALE AND IMMATURE MALE AND FEMALE (first-year plumage).—Similar to the equivalent plumages of *septentrionalis*, but having the upper side much more reddish (approaching Mars brown, R. XV) without the cinnamon-sandy tinge of *septentrionalis*; the under parts are also much more reddish, particularly in males of the first-year plumage, which have the breast between peach-red and scarlet (R. I). There is very little individual variation.

The immature male differs from the adult female in this subspecies, aside from the usual characters of immaturity on the wing, in the more strongly rufous tinge of the upper parts, in the brighter scarlet of the under parts, in the broader ochraceous edges of the secondaries, and in the more pronounced ochraceous bar across the upper side of the wing.

	WING	TAIL
2 ♂ ad.	60, 60	40, 40
4 ♂ imm.	59-61 (60.0)	38-41 (39 2)
2 ♀ ad.	59, 60	40, 40
1 ♀ imm.	59	38

RANGE.—Kulambangra Island, Solomon Islands.

All the specimens were collected in October and are in fairly fresh plumage. No bird shows any signs of molting.

Plumages in *Petroica multicolor*

The study of the plumages in this species is of particular interest. It shows that we have to distinguish between progressive and retarded plumages as characters either of geographical or of individual variation. I have discussed in detail the occurrence of such plumages in one of my recent papers (Amer. Mus. Novit., No. 666), but several additional points must be discussed in connection with my studies on the plumages of *Petroica*.

In order to simplify a review of my findings, a few words on the normal plumages in *Petroica* may be of advantage. The typical adult male is black on the upper side, and on the under side almost unpigmented with a rich scarlet coloration. The typical adult female is brown-

ish above, and below dull pale scarlet with a distinct ochraceous wash. This pronounced sexual dimorphism can be decreased either by the male assuming a female-like plumage, or the female assuming a male-like plumage.

STYLES OF SEXUAL DIMORPHISM

<i>Petroica multicolor</i>	<i>feminina</i> <i>soror</i>	<i>multicolor</i> <i>kleinschmidti</i> <i>becki</i> <i>ambrynsensis</i> <i>similis</i> <i>septentrionalis</i> <i>kulambangrae</i>	<i>pusilla</i> <i>polymorpha</i>
♂ ad.	○ retarded	● typical	● typical
♀ ad.	○ typical	○ typical	● progressive

Of the eleven subspecies of *multicolor*, seven have the normal degree of sexual dimorphism, but four have it diminished, either by a change in the male plumage (*feminina* and *soror*) or by a change of the female plumage (*pusilla* and *polymorpha*). It is the same type of variation that we find in the genera *Pachycephala*, *Cyornis*, and probably many other genera of birds, although very little investigating has yet been done with this problem in mind.

The important point—particularly important in view of the recent work on feather physiology—is that the feather follicles of the various races apparently react differently to the sex hormones. It seems obvious that the feather follicles in *Petroica* are more independent of the sex hormones than they are in *Gallus*.

Retarded and progressive plumages occur in *Petroica* as characters not only of geographic variation, but also of individual variation. I have described a good many specimens of that kind on the preceding pages. They all seem to confirm the opinion that I expressed in my latest paper on this subject: namely, that the development of these plumages is largely independent of the development of the gonads.

I have quoted A. Miller in my recent paper for the opinion that the type of a feather was closely correlated with the condition of the gonads during the time of the development of this feather. Still more specific about this is Verwey (1930, Jour. f. Ornith., LXXVIII, p. 234). The opinion held by many ornithologists is that adult or intermediate feathers in an immature bird are directly caused by hormonal influences during

the growth of these feathers. Contrary to this, I have developed in my latest paper the opinion that the change from an immature to an adult feather type is largely independent of gonadal influences, at least in the species without a nuptial plumage.

A study of the recent literature of experimental physiology shows that the tendency to neglect the genetic constitution of the feather follicles, which culminated around 1927, is gradually being overcome. It is now suspected that even in the fowl the feather follicles of male and female have different potentialities. However the hormonal thresholds are so similar that it needed a special technique to discover this. (See Masui, 1933, Roux' Archiv, CXXVIII, pp. 1-14).

What is true for the sexual dimorphism also holds true for the age dimorphism and the differentiation of feather follicles. It may be of interest to the ornithologist who is not familiar with the literature on experimental zoology, to quote some of the recent writers on this subject: "Up to the present time the type of feathering, as regards secondary sexual characteristics, has been believed to be wholly under endocrine control (Lillie, 1927, Jour. Exper. Zool., XLVIII, pp. 175-196). Nevertheless the [skin] graft from a brown Leghorn female to a barred Plymouth Rock male produced cock feathers in advance of the host, and the graft from a Plymouth Rock male to a Minorca male produced cock feathers later than the host, but earlier than the donor [of the graft]. . . . The time at which a young fowl assumes its adult plumage may depend not alone on the establishment of a certain endocrine balance, but also upon the age at which the feather follicles become responsive to particular stimuli" (Danforth, 1929, Genetics, XIV, p. 268). In another paper Danforth shows that the feather follicles may react differently to hormonal influences even in closely related breeds of fowl: "These results may be readily interpreted on the assumption that it is primarily the tissues and not the hormones which determine effects. Hormones have probably remained essentially the same throughout the phylogeny of vertebrate classes, since those of mammalian elaboration are known to be readily utilized by such forms as birds and amphibians. In a number of forms . . . sexual dimorphisms in plumage . . . are dependent for their realization on particular endocrine environments of the feather follicles. But some other forms have not acquired the capacity to respond differentially to these factors in their internal environment. . . . In one case, a hormone may seem to be a very potent agent, in another a quite inert substance. The experiments show that different [domestic] races of a single species may exhibit very different responses to the same hormone"

(Danforth, 1933, Jour. Exper. Zool., LXV, p. 192). The conditions in the genera *Petroica*, *Pachycephala*, and *Cyornis* are of almost the same nature as those described by Danforth from the domestic fowl, only much more pronounced.

There is additional evidence concerning the age in which individual feather follicles produce specific patterns, and the investigation of the sequence of patterns may have some evolutionary significance. Dunn and Landauer studied a breed of Hamburg fowl which is "silver spangled" in its adult plumage, but shows "cross pencilling" in immature feathers. They say: "The observation of a specific pattern (cross pencilling) which appears early from the same follicles which later produce spangled feathers is interesting since this pattern characterizes the adult feathers of the "Pencilled" Hamburg variety and is apparently a primitive type distributed throughout gallinaceous birds. . . . The chief ontogenetic significance of such differences between successive feathers, however, is in demonstrating the wide range of responsiveness of the feather follicles during early growth" (Dunn and Landauer, 1930, Storrs Agric. Exper. Station, Bull. 163, p. 45). The study of the responsiveness of feather follicles in the period between immaturity and maturity seems to promise very interesting results. Kuhn (1932, Roux' Archiv, CXXVII, pp. 502-519) has done a great deal of work on this problem, but new lines of research have been opened up since the injection of hormone extracts has become possible. It is now possible—at least in the fowl—to determine for every part of the body when the feather follicle enters the adult condition, as shown by its response to the female hormone: "The female hormone consistently determines the development of female plumage in the male [Brown Leghorn fowl], but only at such a period [of age], when the potentiality of female feathering as such has become differentiated within the feather germ" (Juhn, Gustavson, and Gallagher, 1933, Jour. Exper. Zool., LXIV, pp. 133-186).

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A REVIEW OF THE RACES OF *BUTHRAUPIS EXIMIA* (BOISSONNEAU)¹

BY ROBERT T. MOORE

Brabourne and Chubb, in 'The Birds of South America,' retained *Buthraupis eximia* (Boissonneau) and *Buthraupis chloronota* (Selater) in the genus *Buthraupis* Cabanis and gave full specific rank to *chloronota*. Penard (1919, Auk., pp. 536-540) divided the genus *Buthraupis* into three genera, creating a new generic name, *Cnemathraupis*, to include both *eximia* and *chloronota*. However, he reduced *chloronota* to subspecific rank and called it *Cnemathraupis eximia chloronota*. In his 'Distribution of Bird-life in Ecuador,' 1926, p. 669, Dr. Chapman did not recognize *Cnemathraupis*, but recorded *chloronota* as a subspecies of *eximia*. He had previously noted² that birds from the central Andes of Colombia "have a slight trace of blue on the rump, indicating the probability of intergradation between these representative races" and that the birds from Paramillo of the western Andes "are without blue on the rump—the blue lesser wing-coverts" do not "cover the black bases of the greater coverts as they apparently do in 'Quito' " specimens. Most of the latter were trade-skins without reliable data. Lack of material with full data seemingly made him hesitate to describe the Paramillo bird as new. The securing of fresh material from Ecuador proves that the birds of the western Andes of Colombia are distinct, and that the specimens from the Mt. Sangay area of south Ecuador also constitute a new race. Therefore I describe these two as new and recognize the two previously described forms, *Buthraupis eximia eximia* (Boissonneau) from the eastern Andes of Colombia, and *Buthraupis eximia chloronota* (Selater) of north Ecuador.

My thanks are offered to Dr. Frank M. Chapman for permission to examine the specimens in The American Museum of Natural History, and particularly for his gracious courtesy in allowing me to describe a new race from material on which he has previously worked. The specimens for the Mt. Sangay race are all from my own collection.

¹ Contribution from the California Institute of Technology

²1917, 'Distribution of Bird-life in Colombia,' p. 603

***Buthraupis eximia zimmeri*, new subspecies**
Green-rumped Mountain Tanager

TYPE.—Male adult in partly molted plumage; No. 134377, American Museum of Natural History; Paramillo, western Andes, Antioquia, Colombia; alt. 12,500 feet; Jan. 25, 1915; Miller and Boyle, collectors.

SUBSPECIFIC CHARACTERS.—Nearest to *Buthraupis eximia eximia* (Boissonneau), but rump Cress Green¹ instead of Light Windsor Blue, and yellow of under parts darker. It differs markedly from *Buthraupis chloronota* (Sclater) of the western slope of the Andes of north Ecuador in that the wings and tail are shorter; pileum glittering, metallic Windsor Blue instead of much duller Acetin Blue; auriculars and sides of neck intense black with conspicuous sheen, instead of being veiled with dull Acetin Blue, the black sharply defined from blue of crown; throat and breast pure black with sheen instead of dull black; under wing-coverts bordered with dark green, instead of black or whitish buff.

GEOGRAPHICAL DISTRIBUTION.—Temperate Zone of western and central Andes of Colombia—Paramillo, Santa Isabel, and Almaguer.

DESCRIPTION OF TYPE.—Pileum glittering metallic Windsor Blue, mixed with black on anterior border of forehead, sharply defined by a narrow dull band of Dusky Violet Blue (2) along posterior border of nape; interscapular area, rump, and upper tail-coverts Cress Green; sides of neck, postocular and auricular regions, lores, superciliary line, throat, and upper breast black with a slight sheen; chin black, the fine shafts of the feathers whitish, creating hairlike lines; remainder of under parts except under tail-coverts, Light Cadmium streaked with darker; under tail-coverts Ochraceous-Tawny, the feathers margined with Yellow Ocher; lesser wing-coverts glittering metallic Light Windsor Blue in high light, Windsor Blue in low, not covering the black bases of the greater coverts, creating a broad black wing-bar; outer margins of greater coverts obliquely bordered with Chromium Green; primaries black; secondaries black, the outer webs bordered with Parrot Green; under wing-coverts black bordered with Nickel Green; bend of wing Windsor Blue changing to black posteriorly with faint or no yellow spot; rectrices black; bill, legs, and feet black.

ADULT FEMALE.—Similar to male in color and size.

REMARKS.—The new race differs from typical *Buthraupis eximia chloronota* (Sclater) in the characters mentioned under "subspecific characters," and in addition the dull band of dusky violet on the nape is sharply defined from the green of the back, whereas in *chloronota* the Acetin Blue of the hind neck gradually merges into Dark Tyrian Blue posteriorly, which itself merges into the green of the interscapular region; the blue of the lesser wing-coverts is a darker blue, on the average. Most specimens of *chloronota* from the Quito region exhibit a small spot of yellow on the edge of wing about an inch and a half below bend of wing; but eight of the ten specimens of the new race do not reveal any spot and only two have the faintest trace of it.

¹ Names of colors in this paper when capitalized are taken from Ridgway's "Color Standards and Color Nomenclature," 1912.

The birds of the central Andes of Colombia do show a trace of blue on their rumps, but they are much closer to *zimmeri* than to true *eximia*. In fact, a female from Paramillo in the western Andes has a faint trace of blue and represents the extreme tendency toward green. Therefore it seems best at present, until the securing of more material throws further light on the problem, to classify the birds of the central Andes as *zimmeri*. If they prove to be true intermediates, it seems certain that they intergrade between *eximia* and *zimmeri*. Two of the eight specimens which I have examined come from Almaguer in southern Colombia, 200 miles closer to the range of *chloronota* than Paramillo, which is the type locality of *zimmeri*, and yet these birds of Almaguer are much closer to *zimmeri* than to *chloronota*. It may be unwise to forecast from this that *zimmeri* will be found to occur in the southern extension of the western Andes. At any rate I do not feel confident of evidence of intergradation between *eximia* and *chloronota*, nor, on the other hand, do I deem it wise in our present lack of knowledge to reëlevate *chloronota* to specific rank.

I take pleasure in dedicating this form to Mr. John T. Zimmer of The American Museum of Natural History.

SPECIMENS EXAMINED.—COLOMBIA: Paramillo, western Andes, 1 ♂ (type), 1 ♀; Santa Isabel, Quindio Andes, 4 ♂, 2 ♀; Almaguer, central Andes, 1 ♂, 1 ♀.

***Buthraupis eximia eximia* (Boissonneau)**

Blue-rumped Mountain Tanager

SUBSPECIFIC CHARACTERS.—Nearest to *Buthraupis eximia zimmeri*, but rump light Windsor Blue instead of Cress Green and yellow of under parts lighter.

GEOGRAPHICAL DISTRIBUTION.—Temperate Zone of the eastern Andes of Colombia.

REMARKS.—I have only inadequate material at hand. A female from El Piñon not only has a blue rump, but the interscapular area is faintly mottled with blue, the outer margins of the secondaries are duller—Pois Green—and there is a small concealed patch of white on the throat. These may be individual variations.

SPECIMENS EXAMINED.—COLOMBIA: eastern Andes, El Piñon, 1 ♀; Palo Hueco, 1 ♀; Aguaditas, 1 (?); "Bogotá," 2 (?).

***Buthraupis eximia cyanocalyptra*, new subspecies**

Blue-veiled Mountain Tanager

TYPE.—Male adult; No. 7027, collection of Robert T. Moore; San Luis, near Mt. Sangay, Ecuador; July 8, 1932; original field number, Ec-016k.

SUBSPECIFIC CHARACTERS.—Nearest to *Buthraupis eximia chloronota* (Sclater), but black mask of throat and chest extending farther posteriorly on the under parts, the rather dull Cyanine Blue of the nape bordered posteriorly by a wider band of Deep

Medici Blue, the latter extending in a triangular point farther around on the sides (partly concealed) into the black of the chest; under wing-coverts margined with a rather wide border of bright yellow, in many specimens creating continuous bars, which reach the border of the wing and form a large yellow spot about an inch below the bend of the wing. Females resemble the males, but the yellow borders of the under wing-coverts are more extensive, and the tail seems to be smaller, at least than the tail of the single female which is available, with full data, from north Ecuador.

GEOGRAPHICAL DISTRIBUTION.—The humid Temperate Zone of the great labyrinth of ash canyons of Mt. Sangay on the eastern slope of the Andes in south-central Ecuador, the valley of San Luis and probably other Temperate Zone valleys in its vicinity. I have not seen the "three pairs" of this species, which Stolzmann¹ secured in 1885 at San Rafael on the eastern slope of Mt. Tunguragua to the north of Sangay, nor the specimens which Dr. Chapman noted that Menegaux² reported as having come from Macas to the southeast of Sangay. Taczanowski and Berlepsch, who recorded Stolzmann's specimen, state that San Rafael has an elevation of 9000 feet. Therefore it may well be in the humid Temperate Zone and specimens taken there or above it may represent this race. On the other hand, Macas is reported by Dr. Chapman³ to have an elevation of only 3448 feet, which would indicate that it is at the lower limit of the Subtropical Zone. As *Buthraupis eximia* and all its known races come from the Temperate Zone, I doubt the occurrence of this race at such a low altitude. Menegaux's report covered not only specimens with full data, obtained by Dr. Rivet, but also a heterogeneous lot from various sources. Dr. Chapman points⁴ out that many of these "native-made skins" and many of the localities are "often obviously erroneous."

DESCRIPTION OF TYPE.—Crown Deep Dull Violaceous Blue, hind neck (occiput) and nape Cyanine Blue with only very slight or no sheen, not sharply defined from the succeeding band of Deep Medici Blue of the anterior portion of the interscapular region, which band is nearly 15 mm. wide and extends around to the sides of the neck in a triangular point, whose apex is concealed by the black feathers of middle throat; remainder of back Parrot Green with dark shaft-streaks; rump Forest Green with one or two feathers very faintly tinged with blue; upper tail-coverts Parrot Green, the posterior ones very finely tipped with yellow; chin, malar region, throat, upper breast and sides of neck black, with gray shaft-streaks of the feathers of chin and throat rather prominent; black feathers of sides of neck and upper breast bordered with very fine tips of gray; middle of throat with a concealed pure white patch, the feathers around it having their bases gray; feathers of chin developed into a prominent brush of very stiff extrorse bristles; feathers of lores black with buffy centers; feathers of anterior border of forehead black at base, buff in the center and margined with blue; eye-ring and subocular region black, the feathers of the latter with wide buffy shaft-streaks; auricular region with feathers black faintly tipped with dark blue; remainder of under parts, except under tail-coverts, Light Cadmium streaked with darker; under tail-coverts Ochraceous-Tawny, the feathers tipped with Primuline Yellow; feathers of legs greenish black with very wide tips of Empire Yellow; lesser wing-coverts brilliant metallic Light Grayish Violet-Blue in high light, Dull

¹ 1885, *Proceedings of the Zoological Society of London*, p. 8.

² *Étude des Oiseaux de l'Équateur, Zoologie*, IX, pp. 1-128.

³ 1926, *Distribution of Bird-life in Ecuador*, p. 712.

⁴ 1926, *Distribution of Bird-life in Ecuador*, p. 734.

Violet-Blue in low, nearly covering the black bases of the greater coverts; the outer margins of greater coverts obliquely bordered by Chromium Green, the primary coverts black, bordered with a very fine line of Eton Blue; primaries black, the second to the ninth having a touch of green on the center of the outer margin; secondaries black, the entire outer edge margined by a fine border of Parrot Green, the border increasing in width on the inner secondaries; axillars black broadly tipped with green; under wing-coverts grayish black, broadly tipped with Reed Yellow, creating a yellow-barred effect, the lower bar reaching to the edge of the wing and ending in a bright spot of Empire Yellow; rectrices black; bill, legs, and feet black.

ADULT FEMALE.—Similar to male, but the yellow borders of the under wing-coverts more extensive, in one specimen covering half the exposed surface of the coverts.

REMARKS.—In addition to the "subspecific characters" mentioned above, there are several incipient or well-developed ones; every one of my thirteen specimens possesses a very prominent brush of very stiff extrorse bristles on the chin, which seem to be absent from *eximia zimmeri*, and only slightly apparent in *chloronota*. A concealed white patch appears in the center of the black throat, quite large in some specimens and represented in *eximia chloronota* by grayish bases to the feathers, with the exception of my specimen from the eastern side of the Andes at Papallacta, which possesses an incipient white spot. This spot is also faintly represented in a specimen of true *eximia*. It reaches its greatest development in *cyanocalyptra*, where it appears prominently in six of my seven males, but in only one of the females, although all of them have extensive gray bases to the feathers of the throat and upper breast. In all of my male specimens, the feathers of the black mask, particularly those of the sides of the neck, possess a fine border of gray. This border wears off in worn plumage; however, the birds were collected from July to September, and five females collected in the same period do not show it. There is no trace of it in my specimen of *chloronota* collected in September nor in a January specimen of *zimmeri*. Five of the males have very fine yellow tips to the longer upper tail-coverts. Only one female exhibits this. The crown and nape in *cyanocalyptra* show slightly darker with less sheen in series and the rump averages darker. Wing and tail measurements of *chloronota* are somewhat larger than those of *cyanocalyptra*—five and six per cent, respectively. The yellow border to the under wing-coverts is very prominent in the latter, differentiating it from *chloronota*, but a single specimen from Mt. Corazon displays a narrow yellow border to the posterior row only of the coverts. The others from Mt. Pichincha and "Quito" have none or only faint traces.

SPECIMENS EXAMINED.—ECUADOR: San Luis, 1 ♂ (type), 2 ♂; Culebrillas Valley, near Mt. Sangay, 4 ♂, 6 ♀.

***Buthraupis eximia chloronota* (Sclater)**

Green-backed Mountain Tanager

SUBSPECIFIC CHARACTERS.—Nearest to *Buthraupis eximia cyanocalyptra*, but black mask of throat and chest less extensive posteriorly on under parts, the Medici Blue of the interscapular area more extensive, the under wing-coverts without yellow borders or only faint traces. It differs from *eximia eximia* in having green rump instead of blue; from *zimmeri* in having darker, duller pileum, and is larger in size.

RANGE.—Humid Temperate Zone of western slope of Andes of north Ecuador.

REMARKS.—*Buthraupis eximia chloronota* was described by Sclater as *Buthraupis chloronota* in the Proceedings of the Zoological Society of London, 1854, pp. 97–98, Pl. LXIV. The habitat was given as “In Republ. Equatoriana.” Sclater remarks: “I have seen only one specimen of this species, which was received by the Frères Verreaux of Paris from Ecuador. It is closely allied to *B. eximia*, but is larger in all its dimensions, nearly equalling in size *B. cucullata*.” The plate adds conclusive evidence that Sclater had a specimen of the north Ecuadorian bird. It is the largest of all the races of *eximia* and the only one approaching *B. cucullata* in size. The plate shows the nape without the dusky violet border, the crown a dark blue, the lesser wing-coverts covering the black bases of the greater coverts—all characters distinguishing this race from *eximia zimmeri* of Colombia. It seems equally certain that Sclater’s specimen was not from the eastern humid Temperate Zone of south-central Ecuador. The black throat and chest-patch are much restricted posteriorly, the auriculars are jet black, the nape is sharply defined from the green back, and the chin, throat, and sides of the neck lack the gray cast, caused by the whitish shaft-streaks and gray margins of the feathers of these areas in the south Ecuadorian bird. Sclater has given the measurement of the type in inches, which, when transposed into the metric system, indicates the larger size of the north Ecuadorian bird. The only problem left is whether the type came from the humid Temperate valleys of the western or the eastern Andes. In the middle of the nineteenth century many collections were made on the easily accessible Mt. Pichincha within sight of Quito, the capital of Ecuador. Quite a number of expeditions have secured specimens of *chloronota* from Mt. Pichincha, and Dr. Chapman found them at Yanacocha on the northwest side of that mountain in 1922. Pichincha was the most accessible hunting ground of the native collectors of the Quito area. I designate the type locality of *Buthraupis eximia chloronota* (Sclater) as the humid Temperate Zone of Mt. Pichincha near Quito, Ecuador.

I have seen only one specimen of *chloronota* from eastern north Ecuador—a male collected by my own party in the valley of Baños just

above Papallacta. Goodfellow obtained one or two specimens near there. My specimen is intermediate between *chloronota* and *cyanocalyptra*. Although it has the large wing measurements and restricted black mask of *chloronota*, it resembles the Sangay birds in other characters. As the Baños Valley is on the same slope of the Andes as the Sangay canyons, a closer relationship would be anticipated. No final decision as to its status can be made until a larger series is assembled.

SPECIMENS EXAMINED.—ECUADOR: Yanacocha, 1 ♂, 1 ♀; "El Corazo," 1 ♂; "Quito," 2 ♂; "Ecuador," 3 ♂; Baños de Papallacta, east Ecuador, 1 ♂.

GENERAL SUMMARY

There are, therefore, four forms in the *Buthraupis eximia* group, ranging from northeastern Colombia to the eastern slopes of the south-central Andes in Ecuador. We have in the extreme northeast *eximia eximia*, a small bird with a blue rump and brilliant metallic light-blue pileum. In the central Andes of Colombia the blue rump begins to change to green, and when it reaches the western Andes the blue is entirely replaced, but the size is unchanged. In the humid Temperate valleys of the western slopes of the Andes in north Ecuador a larger bird has developed, retaining the green rump of *zimmeri*, but losing the glittering metallic Windsor Blue crown possessed by both *zimmeri* and *eximia eximia*. The green border to the under wing-coverts is also lost. Finally, on the eastern slopes of the south-central Andes of Ecuador there is a tendency for the greens to change to yellows and the black areas to become duller. The border to the under wing-coverts is bright yellow instead of the green of *zimmeri*, the long upper tail-coverts are faintly bordered with yellow, the green of the upper part of the interscapular area is veiled by a wide band of Medici Blue, which now extends deep into the black of the chest and covers the auricular area; and the black of the throat and chest area is dulled by gray tips to some of the feathers and the development of a partially concealed white spot on the throat.

My experience with *cyanocalyptra* and *chloronota* in Ecuador leads me to believe that it is confined to the humid Temperate Zone. Like so many species of this zone, which Dr. Chapman has shown¹ are wholly unlike those of the arid Temperate being derived from the arid South Temperate, the races of *eximia* are probably derived from forms in Colombia. It has been shown that the Temperate Zone appears as detached areas in the western Andes of Colombia, and that on the other hand the arid Temperate occupies a considerable area between north-

¹ 1926, 'Distribution of Bird-life in Ecuador,' p 109

central Ecuador and southern Colombia, which is accentuated as a barrier by the large and arid canyon of the Guallabamba, running east and west. Whether or not the humid Temperate Zone is sufficiently discontinuous between Almaguer and Mt. Pichincha to prevent the extension of *zimmeri* directly south along the western slopes of the Andes, is still a question that cannot be answered. Dr. Chapman's¹ conclusion in his highly illuminating discussion of the Temperature Zone affinities of Ecuador seems to be well-founded in its claim that the "faunal connection of the humid Temperate Zone of the eastern Andes of Ecuador appears to be with the Central Andes of Colombia." If, therefore, there is an area of intergradation between the representatives of *zimmeri* of Almaguer, Colombia, and *chloronota* of the Mt. Pichincha area, I suspect it will be found on the eastern slopes of the Ecuadorian Andes, rather than on the western. It seems a reasonable speculation that *chloronota* arrived in the Mt. Pichincha area via the humid Temperate Zone of the eastern Andes rather than from the north.

TABLE OF COMPARATIVE MEASUREMENTS

MALES	WING	TAIL	EXPOSED	
			CUL- MEN	TAR- SUS
3 specimens (not sexed, presumably males) from eastern Andes, Colombia (<i>eximia</i>)	107.9	83.9		
6 adults from central and western Andes, Colombia (<i>zimmeri</i>).	107.1	86.3	14.8	30 4
1 adult from Mt. Pichincha, western slope of Andes, north Ecuador (<i>chloronota</i>).	121.2	98.8	15.1	31.9
4 trade skins from "Quito" (<i>chloronota</i>)	119.1	97.9	15.0	32.3
Type of <i>chloronota</i> , inches reduced to mm. ²	116.8	96.5		
1 adult from Papallacta, eastern slope of Andes, north Ecuador (<i>chloronota</i> ?)	121.6	92.4	16.1	33.8
7 adults from Sangay area, eastern slope of Andes, south Ecuador (<i>cyanocalyptra</i>).	113.5	92.6	14.7	31.7
FEMALES				
2 adults from eastern Andes, Colombia (<i>eximia</i>).	105.8	82.2		
4 adults from central and western Andes, Colombia (<i>zimmeri</i>).	106.9	87.0	14.6	
1 female from Mt. Pichincha, western slope, north Ecuador (<i>chloronota</i>)	115.2	101.3	16.4	
6 adults from Sangay area, south Ecuador (<i>cyanocalyptra</i>)	110.5	90.3	15.4	

¹ 1928, 'Distribution of Bird-life in Ecuador,' p. 97.² 1854, Proceedings of the Zoological Society of London, p. 97.

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TWO NEW SPECIES OF SHEEP-LIKE ANTELOPE FROM THE MIOCENE OF MONGOLIA¹

By GUY E. PILGRIM²

The antelope remains which form the subject of this paper were collected in Mongolia in 1930 on the Tung Gur tableland (Lat. 43° 35'; Long. 112° 40') by Dr. W. Granger, who has kindly entrusted them to me for description. The deposit is isolated from other Tertiary beds of known age, so that its exact stratigraphical relations cannot be observed. The fauna differs from that of the North China Red Beds with *Hipparion* and from the *Hipparion* fauna described by Schlosser from Inner Mongolia, both referred to the Pontian, and is considered to indicate that it belongs to a period previous to that, which may be the equivalent of the Sarmatian or even earlier.

The Oiocerine antelopes form the largest part of the fauna, at any rate after the Proboscidea, which include the very abundant *Platybelodon grangeri* and a single ramus of *Serridentinus gobiensis*, which have been described by Osborn and Granger (Amer. Mus. Novitates, Nos. 470, 1931, and 537, 1932). A Giraffoid of the *Palaeotragus* group is fairly common and Cervidae rather less so. There is a *Listriodon*, apparently closely allied to *L. pentapotamiae* common in the Chinji stage of India. Rhinocerotidae also occur. Equidae are extremely rare, but the absence of *Hipparion* seems to be significant, especially since a palate and lower jaws of the older genus *Anchitherium* have been recovered from these beds. Chalicotheres were present and show rather close relationship with *Macrotherium*. The Carnivora are represented by a fine skull of *Hemicyon*, by a *Hyaena* of the type of *Crocota carnifex*, by an *Ichthytherium* and by a felid closely allied to or identical with *Metailurus*. Rodents have also been found.

Both the Oiocerine species seem, by their short, upright and only slightly twisted horns, to be more primitive than the Pontian forms belonging to this group. It is true that one of them, *Oioceros* (?) *grangeri*, attains a larger size than any form hitherto ascribed to *Oioceros*, and therefore is probably a terminal species. On the other hand, *Oioceros* (?)

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 124.

²Formerly of the Geological Survey of India.

noverca is a small species, which might have been ancestral to one of the Pontian *oiocerines*.

Oioceros Gaillard 1902

Oioceros GAILLARD, 1902. Bull. Soc. Anthropol. Lyon, XX, p. 93, fig. 8.

GENOTYPE.—*Antilope rothii* Wagner, 1857. Abh. Bayer. Akad. Wiss., VIII, p. 154, Pl. vi, fig. 20.

REMARKS

The genus *Oioceros* was founded by Gaillard (1902, p. 93) for the species *Antilope rothii* Wagner (1857, p. 154) from Pikermi, provisionally referred by Gaudry (1865, p. 297) to the living genus *Antidorcas*. Until now four other species have been included in *Oioceros*. These are: *Antidorcas* (?) *atropatenes* Rodler and Weithofer (1890, p. 767) from Maragha; *Oioceros* (?) *proaries* Schlosser (1904, p. 73) from Samos; *Oioceros boulei* De Mecquenem (1925, p. 13) from Maragha; *Oioceros wegneri* Andree (1926, p. 170) from Samos.

De Mecquenem (1925, p. 12, Pl. vii, fig. 7) very briefly described and figured a skull from Maragha, which he attributed to *Oioceros rothii*. Professor Boule has kindly afforded me an opportunity of studying the specimen in Paris, but I do not find myself in agreement with De Mecquenem on the specific identification. The poor state of preservation of the horn-cores, which are not only fractured near the base but are also much battered, does not, in my opinion, permit even the reference to *Oioceros* to be made with certainty. At the same time the expansion of the orbital roof, the character of the upper molars, which are very similar to those of *Oioceros boulei* and *Oioceros* (?) *grangeri*, and the structure of the basicranium, which recalls that of *O. (?) grangeri*, render the generic reference probable. The faint ribbing still visible on the horn-cores shows no character which would tend to contradict this opinion. The much greater backward tilt and the much greater divergence of the horn-cores seem to render the reference to *Oioceros rothii* out of the question. In regard to the former character, it resembles *O. boulei*; in the latter it is approached only by *Oioceros wegneri* and *Ovis kuhlmanni* Andree; in both these last, however, the horn-cores are much larger. There is some resemblance between the Maragha skull and the hornless skull from Samos described and figured by Schlosser under the name of *Oioceros* (?) *proaries*, as will be seen from the table of measurements on pages 24–26. The outline of the skulls, the degree of bending down of the face on the cranial axis, and the shortness of the occiput are alike in both. Considering, however, the greater size of the teeth in *Oioceros* (?) *proaries*, many of the relative dimensions of the two skulls are less

close than would appear at first sight, especially the height of the face which is greater in *O. (?) proaries* and the size of the occipital which is relatively smaller in *O. (?) proaries*. For this reason I think that the Maragha and Samos skulls should be specifically distinguished, and I propose for the former the name of *Oioceros (?) mecquenemi*.

Besides this, two other species are now added: *Oioceros (?) grangeri*, n.sp., and *Oioceros (?) noverca*, n. sp., from Mongolia, not because I am in any doubt that modern usage in zoological classification would justify their generic separation, but because many of the other species listed above are probably equally entitled to rank as separate genera, though their material is insufficient to enable satisfactory diagnoses to be given. In fact the only characters of generic value which they possess in common, so far as material for comparison exists, are the counter-clockwise torsion of the horns (right); the expanded orbital roof; the square and precociously hypsodont upper molars. The diagnosis of *Oioceros* given by Pilgrim and Hopwood (1928, p. 24) was expressly framed so as to be comprehensive and serves to bring out the divergencies of the species amongst themselves. At the same time the eight species form a well-defined group, probably of subfamily rank, confined to the Sarmato-Pontian and showing affinities both to the Ovicaprinae and to the Rupicaprinae. In these circumstances I do not think any useful purpose would be served at present if I were to attempt to divide them into genera or even to frame a generic diagnosis for *O. (?) grangeri* and *O. (?) noverca*, which are the two most completely known of them all.

The same argument would probably favor the provisional inclusion in the genus *Oioceros* of the species from Samos described by Andree (1926, p. 172) under the name of *Ovis kuhlmanni*, especially as from Andree's description we are led to suppose that the hornless skull from Samos which Schlosser called *Oioceros (?) proaries* is the female of an allied species. In any case I do not think that the square molars and the more brachyodont character of the teeth are in accord with the reference to *Ovis*. "*Ovis*" *kuhlmanni* apparently represents an advanced form of the group we are considering, in virtue of the great bending down of the face on the occiput, its long horns and shortened parietals, and so naturally bears a greater resemblance to the living sheep than most other members of the *Oioceros* group. On the contrary, *Oioceros (?) grangeri* and *O. (?) noverca* are probably near the other end of the scale, since their short, simple, upright, slightly twisted horns indicate that they are in a more primitive stage than other species of *Oioceros*. No doubt the Samos no less than the Mongolian species represents a distinct

generic type, but to include it in the living genus *Ovis* is, in my opinion, hardly a procedure calculated to assist palaeontological research.

***Oioceros* (?) *grangeri*, new species**

HOLOTYPE.—Amer. Mus. No. 26508, skull.

PARATYPES.—Amer. Mus. No. 26509, skull; Amer. Mus. No. 26516, left mandibular ramus.

HORIZON AND LOCALITY.—Wolf Camp Quarry. Fifty miles southeast of Iren Dabasu, Inner Mongolia. From the Tung Gur formation, Upper Miocene.

DIAGNOSIS.—An *Oioceros* of larger size than any of the other known species; with face bent down on occiput at an angle of about 30°; breadth of skull at orbits very great; face long; horn-cores standing far apart on the frontals, directly above the orbits, rather upright, forming with the plane of the face an angle of as much as 55° and approximately at right angles to the plane of the occiput; approaching one another up to about one-third their length from the base and then diverging up to the tip, much shorter than in any other species except *O. (?) neverca*, very slightly twisted, not more than one-quarter of a revolution, stout at the base, cross-section almost circular, without a noticeable keel but with numerous coarse anastomosing ribs which follow the torsion of the horns from base to tip, placed on very long pedicles; with a deep lachrymal fossa; fronto-parietal suture far forward, about 17 mm. behind the horn-cores, with a strong swelling round it; occipital surface very concave, in a vertical as well as in a horizontal direction; strong and overhanging lambdoid crest; teeth rather hypsodont; molars relatively large; premolar series short relative to molar series.

DESCRIPTION

The holotype skull is in a fairly perfect state of preservation, the only essential parts missing being the nasals and premaxillae. These are supplied by another skull from the same locality, Amer. Mus. No. 26509, in which the horn-cores, teeth and basicranium are less perfectly preserved. In the holotype the hinder part of the right maxilla is defective and M^2 and M^3 are missing or broken, but the left maxilla and the entire cheek dentition on that side are perfectly preserved. The face is very slightly crushed in the lateral plane. The skull is that of a fully grown animal, since the last molar is somewhat worn. It seems to have been an unusually large individual of the species, since out of some twenty sets of teeth which cannot be separated specifically, those of the holotype are the largest.

The face is bent down on the cranial axis at an angle of about 30°. In relation to the length of the occiput, the face is long, as much so as in the living genus *Ovis* and much more so than in *Capricornis*, *Nemorhaedus* or *Capra*. The skull is extremely broad at the frontals, its width between the orbits considerably exceeding the distance between the hinder margin of the orbit and the occipital condyles.

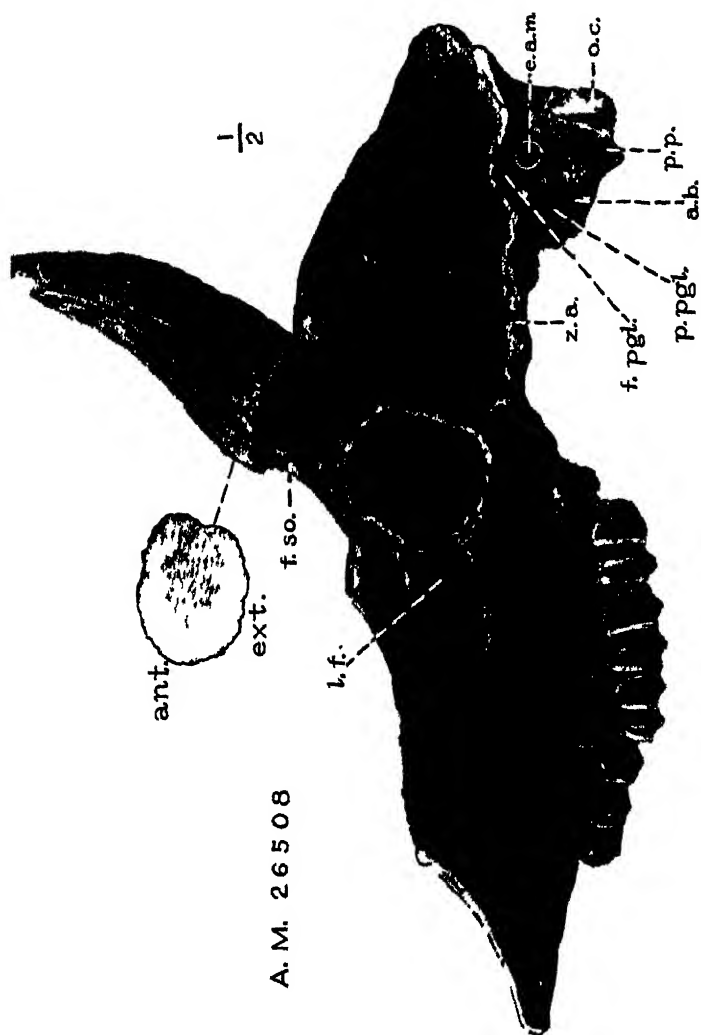


Fig. 1. *Oioceros* (?) *grangeri*, new species, A. M. No. 26508, type. Lateral view of skull with cross section of horn-core at base. One-half natural size. a. b., auditory bulla; e. a. m., external auditory meatus; f. pgl., postglenoid foramen; f. so., supraorbital foramen; l. f., lachrymal fossa; o. c., occipital condyle; p. pgl., postglenoid process; p. p., paroccipital process; z. a., zygomatic arch.



Fig. 2. *Oioceros (?) grangeri*, new species, A. M. No. 26508, type. Superior view of the skull. One-half natural size. f.so., supraorbital foramen.

The horn-cores are situated immediately above the orbits, and if the occiput be placed in a horizontal position, the hinder edge of the horn-core almost coincides with that of the orbit. The horn-cores are placed on exceptionally long pedicles, which lie very far apart from one another on the frontals; they are rather upright, being approximately at right angles to the plane of the occiput and forming an angle of about 55°

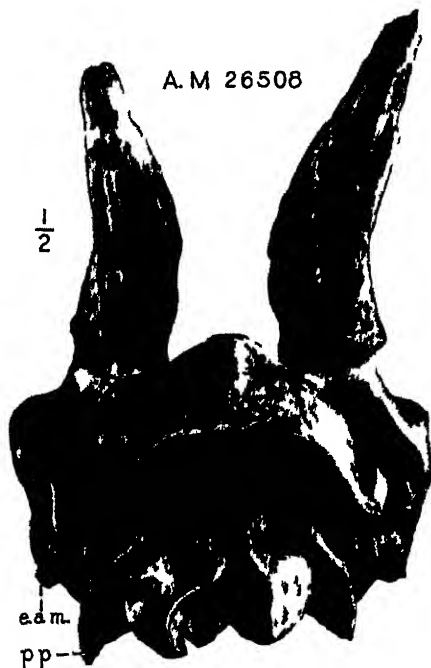


Fig. 3. *Oioceros* (?) *grangeri*, new species, A. M. No. 26508, type. Posterior view of skull. One-half natural size. e.a.m., external auditory meatus; p.p., paroccipital process.

with the plane of the face; they are much shorter than is usual in the genus *Oioceros*, but are stoutly built, with a cross-section broadly oval at the base, the long axis being rather oblique to the cranial axis; they are twisted spirally in a counter-clockwise direction (i.e., for the right horn), but to a very slight extent, the torsion from base to tip not amounting to as much as a quarter of a revolution. There is no noticeable keel, but the surface of the horn-core is covered with numer-

ous anastomosing ribs, which follow the direction of torsion of the horn. The torsion causes the horn-cores to approach one another for about one third of their length and then to recede from one another up to the tip.

The highest point of the skull is at the fronto-parietal suture, which is convex towards the rear and is situated about 17 mm. behind the horn-

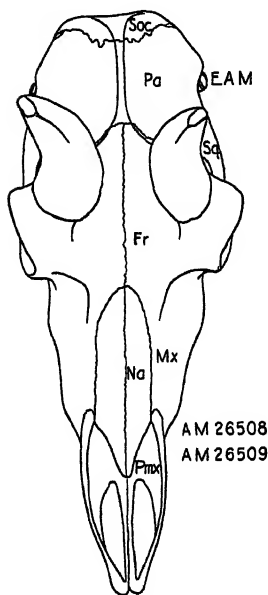


Fig. 4. *Oioceros* (?) *grangeri*, new species. Composite diagram of skull from above. Based on A. M. No. 26508, type, and A. M. No. 26509, paratype. One-fourth natural size. E.A.M., external auditory meatus; Fr., frontal; Mx., maxilla; Na., nasal; Pa., parietal; Pmx, premaxilla; Soc., supraoccipital; Sq., squamosal.

cores. Round this point is a lozenge-shaped inflated area, which is continued both to the front and the rear as a swelling on the parietal suture and on the frontal suture between the horn-cores. In front of the horns the frontals are depressed and the suture itself is flat; the surface rises again to the fronto-nasal suture.

The orbits are of moderate size, almost circular, and their upper margins project considerably beyond the base of the horn-cores. The supra-orbital foramina open into small, narrow, vertical fossae, situated in the pedicles of the horn-cores, and are overhung by the latter. The lachrymal fossae are deep, though less so than in many recent species of *Ovis*. An ethmoidal fissure, if present at all, is of trifling extent.

The nasals are long and narrow; they indent the frontals at an acute angle and reach back almost to the level of the anterior edge of the orbits; their anterior ends are missing in the skull No. 26509, but one may estimate that their tips extended about 20 mm. in front of P². They articulate with the lachrymals and maxillae until they reach the hinder end of the premaxillae, with which they also articulate, though to a less extent than in *Capra*. In *Ovis* the nasals do not articulate either with the maxillae or the premaxillae.

The premaxillae are exceptionally long, even more so than in *Ovis*. They run up between the nasals and the maxillae, with both of which they articulate as in *Capra*, though in that genus the length of the articulation is greater. In *Ovis* the articulation of the premaxilla with the maxilla is longer than in *Oioceros* (?) *grangeri*, but the premaxillae do not articulate with the nasals, although almost in contact

with them. In any case the condition in *Capricornis*, *Nemorhaedus*, *Rupicapra*, *Budorcas* and *Ombos* is entirely different from that in *Oioceros* (?) *grangeri*, since the premaxillae end far in front of the articulation of the nasals with the maxillae.

The brain-case is rather narrow behind the horn-cores, which project considerably beyond it, but widens somewhat to the rear. There are no temporal ridges. A prominent sagittal crest existed, though it is broken off in the holotype.

The supraoccipital occupies a broad area on the surface of the skull, but does not extend very far forward, the suture with the parietal being perfectly clear. The lambdoid crest is very prominent and considerably overhangs the occipital which is extremely hollowed both in a vertical and in a horizontal direction. The occipital has a broadly semi-oval shape; it is rather low, its breadth being much in excess of its height. The occipital crest is shown in the center of its hollow surface. The foramen magnum is not large and the condyles hardly project backward beyond the summit of the occipital crest. The paroccipital processes are rather extended in the anteroposterior direction but are not long. The mastoid process is weakly developed.

The basicranium presents several points of interest, especially since most of the forms hitherto referred to the genus *Oioceros* do not appear to have provided material sufficiently well preserved to admit of satisfactory study. At any rate I have seen no description of the basicranium of any species of *Oioceros*. The basioccipital is subtriangular in shape with a regularly rounded surface on which a median groove is indicated from the foramen magnum up to a point slightly in advance of the posterior tuberosities. The posterior tuberosities show a moderate lateral expansion but have not the great prominence which we find in the oxen. In front of them, narrowing proceeds regularly throughout the course of the basioccipital and basisphenoid, and there is a considerable interval between the basioccipital and the tympanic bulla. The anterior tuberosities are very small, and lie immediately opposite the postglenoid crest. The auditory bulla is small and in particular very short, hardly reaching farther forward than the postglenoid crest; it is but little inflated and projects but little below the level of the basioccipital; its summit forms a sharp-ridged crest in continuation of the antero-posterior diameter of the paroccipital process; internal to this crest the surface of the bulla slopes gently towards the inner side; on the outer side a slight invagination tends to encircle the attachment of the hyoid. The meatal tube projects strongly. Beneath it the very large stylomastoid

A.M. 26508



Fig. 5. *Oioceros* (?) *grangeri*, new species, A. M. No. 26508, type. Inferior view of posterior half of skull. Natural size. a.b., auditory bulla; e.a.m., external auditory meatus; f.l.m., foramen lacerum medium; f.pgl., postglenoid foramen; o., occiput; p.p., paroccipital process; p.pgl., postglenoid process; v.p.h., vagina processus hyoidei.

foramen is exposed, communicating by a small opening with the upper side of the squamosal. The bar of bone which separates the latter foramen from the outer margin is very slender. The foramen lacerum medium faces entirely downward and has bony ridges on either side of it.

UPPER DENTITION.—The molar series is rather long for the size of the skull both as compared with other species of *Oioceros* and also with living species of *Ovis*, *Capra*, *Nemorhaedus* and *Capricornis*. On the other hand, the premolar series is short as compared with other species of *Oioceros*, as well as with the living *Nemorhaedus* and *Capricornis*, but is longer than in *Ovis* and *Pseudois naxura*. The length of the molars but little exceeds the breadth. The crown height in the case of an unworn molar is approximately equal to the length. The median as well as the anterior and posterior folds on the outer side of the molars are very strong. There is a broad but little prominent median rib on the anterior lobe; this is practically absent on the posterior lobe. Median basal pillars are often quite absent on the inner side of the molars and in any case when present are very weak. The three upper premolars approximate in length very nearly to one another, P^4 being slightly the shortest. The transverse diameter decreases in the series from behind forward. Long spurs in most cases project into the central cavity of the upper premolars, producing islands after a moderate amount of wear. The enamel on all the teeth is smooth and unwrinkled.

LOWER DENTITION.—The same relation in size between the molars and the premolars holds in the lower as in the upper dentition. At the anterior end of the molars there is a well-marked fold both on the inner and on the outer side, but it is much stronger on the outer side. On the contrary at the posterior end of the molar there is only a weak fold on the inner side and none at all on the outer side. A fairly strong median basal pillar is present on the outer side of each one of the three molars. The talonid of M_3 is narrow and triangular. P_4 is primitively constituted, the inner cusp being separated by two clefts, which persist almost to the base of the crown, from the two anterior and the two posterior wings. In the external wall, about one-third the way from the front end, there is a deep furrow. P_3 is shorter but has the same structure. An additional low cusp is present at the base of the anterior of the two valleys. P_2 is still shorter; there is no inner cusp; the wings are short, the anterior one especially so. So far as can be seen, considering the much-worn condition of the incisors, their size seems to diminish from I_1 to I_3 , but the difference is not greater than is usual in the living members of the *Ovinae* and *Rupicaprinae* and is quite incommensurate with what obtains in *Antidorcas*, in which I_1 is enormously enlarged.

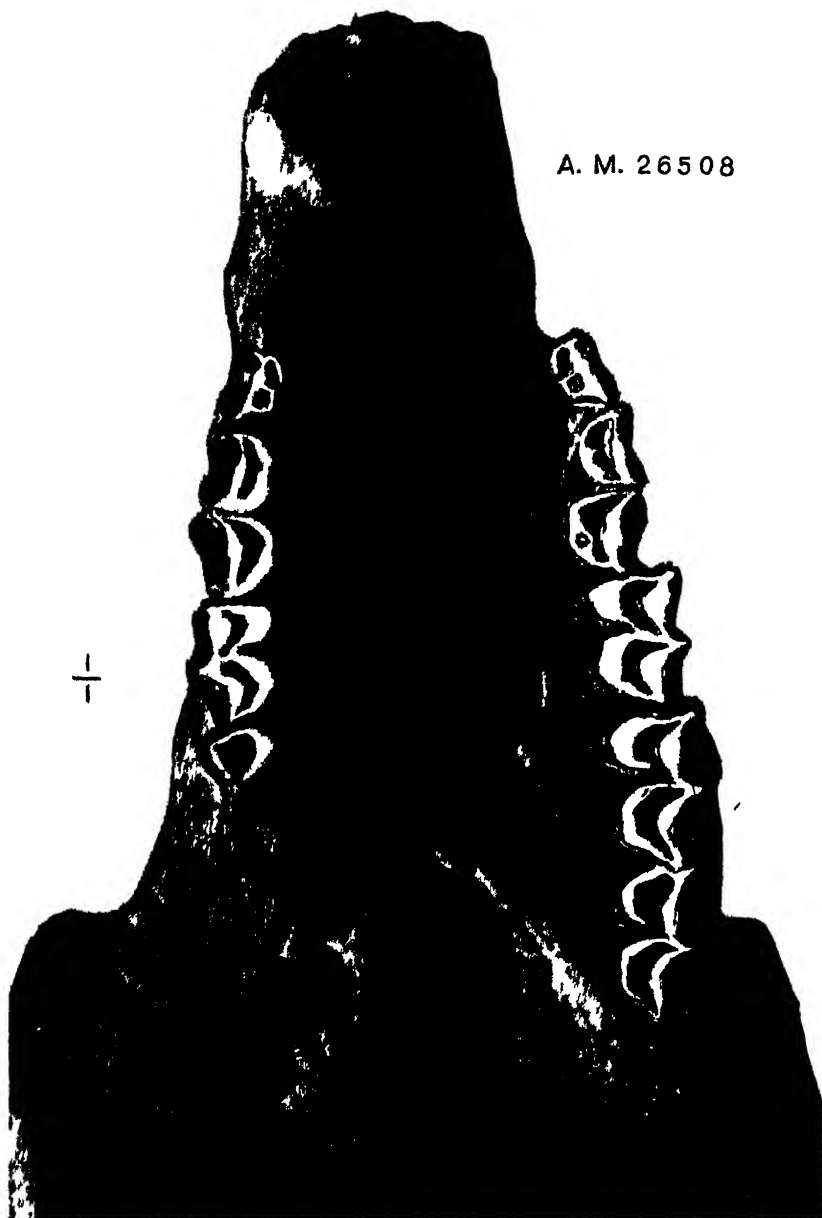


Fig. 6. *Oioceros* (?) *grangeri*, new species, A. M. No. 26508, type. Palatal view of anterior portion of skull. Natural size.

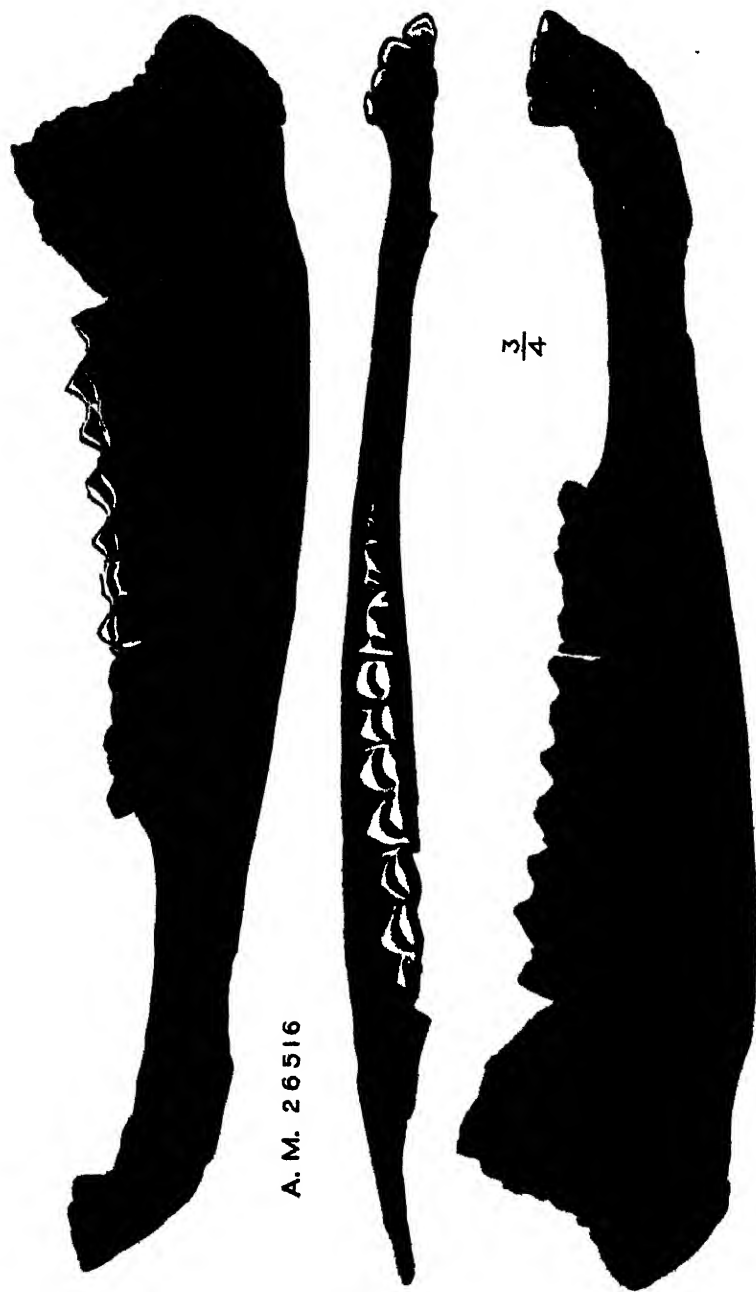


Fig. 7. *Oioceros* (?) *grangeri*, new species, A. M. No. 26516, paratype. Lower jaw: outer, superior, and inner views. Three-fourths natural size.

The diastema between P_2 and the incisors is somewhat longer than in *Ovis*, *Pseudoris* and *Nemorhaedus*, from which we may draw the same conclusion as from the skull: that *Oioceros* (?) *grangeri* had a longer face and mandible than the living *Ovinæ* and *Rupicaprinæ*. On account

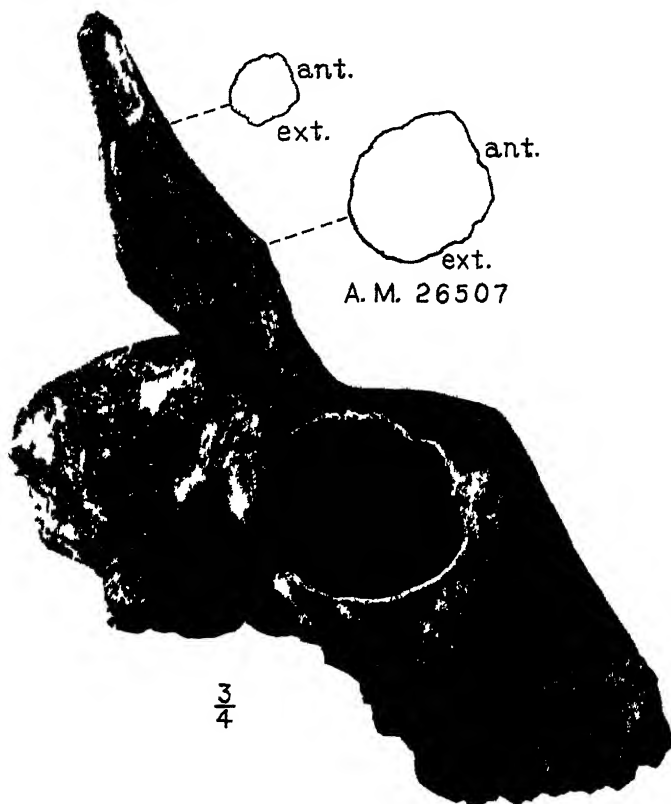


Fig. 8. *Oioceros* (?) *noverca*, new species, A. M. No. 26507, type. Side view of skull with cross sections of horn-core at base and near tip. Three-fourths natural size.

of the poor state of preservation of most of the other species of *Oiocerinae*, it is difficult to be sure whether the same condition obtained as in the Mongolian species, but it seems highly probable that it was so in *O. (?) proaries*, "*Ovis*" *kuhlmanni* and *O. wegneri*.

A. M. 26507



Fig. 9. *Odocoileus* (?) *noveboracensis*, new species, A. M. No. 26507, type. Anterior view of skull. Three-fourths natural size.

Oioceros (?) *noverca*, new species

HOLOTYPE.—Amer. Mus. No. 26507, skull.

PARATYPES.—Amer. Mus. 26223, frontlet; Amer. Mus. No. 26513, left maxilla; Amer. Mus. No. 26515, left mandibular ramus; Amer. Mus. No. 26501, back part of skull.

HORIZON AND LOCALITY.—Wolf Camp Quarry. Fifty miles southeast of Iren Dabasu, Inner Mongolia. From the Tung Gur formation, Upper Miocene.

A. M. 26223

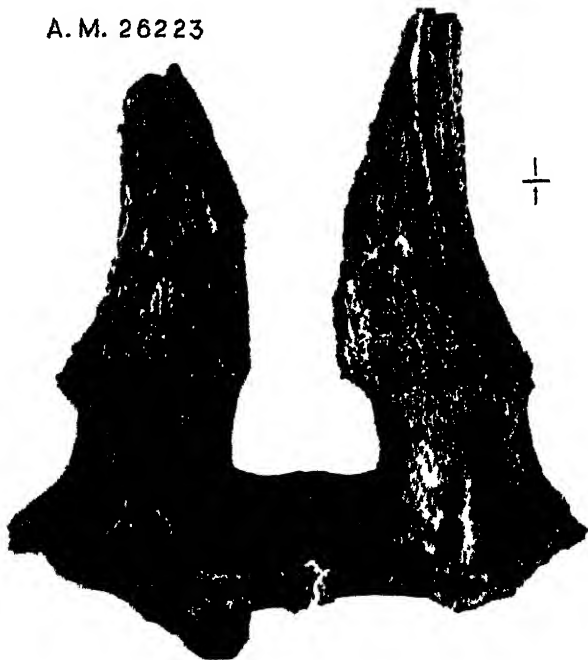


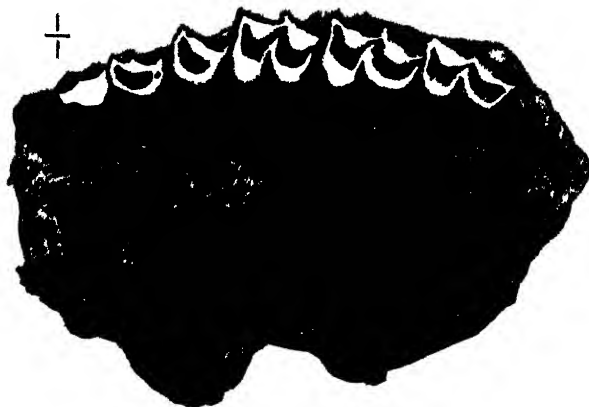
Fig. 10. *Oioceros* (?) *noverca*, new species, A. M. No. 26223, paratype. Anterior view of skull fragment supporting horn-cores. Natural size.

DIAGNOSIS.—An *Oioceros* of about three-quarters the size of *Oioceros* (?) *grangeri* with similar characters and differing only in the following particulars:—premolar series longer; area around the fronto-parietal suture less swollen; basioccipital tending slightly more to an oblong and less of a triangular shape; P_2 rather more complicated with an extra wing on the inner side.

DESCRIPTION

The holotype lacks most of the occiput and the premaxillary region but shows the frontlet as well as the orbits and maxillae, in which are the

much-worn teeth. The frontals above and anterior to the orbit seem to be somewhat distorted. The deficiency as to the hinder part of the skull is supplied by another specimen, Amer. Mus. No. 26501, which shows the basicranium. The upper dentition is better shown on an isolated left maxilla, Amer. Mus. No. 26513. Amer. Mus. No. 26223 is an isolated frontlet, which shows what seems to be the normal structure well, and



A.M. 26513

Fig. 11. *Oioceros* (?) *noverca*, new species, A. M. No. 26513, paratype. Palatal view of left maxilla with cheek teeth. Natural size.

the position of the supraorbital foramina. The left mandibular ramus, Amer. Mus. No. 26515, agrees in size with the skull. It belonged to a juvenile individual, and M_3 is but little worn. It lacks the angle and condyle and the incisor region, but shows the cheek-teeth well.

The agreement with *O.* (?) *grangeri* is very close except in size. The slight differences are sufficiently indicated in the diagnosis.

AFFINITIES OF THE MONGOLIAN SPECIES

The characters by which the two Mongolian species of *Oioceros* differ from those hitherto known seem chiefly to concern the structure and insertion of the horn-cores. They are much shorter, and although the character of the torsion is the same, namely counter-clockwise (i.e., for the right horn-core), it is much less in amount, being only about a quarter of a revolution as against about one revolution in *O. rothii*, *O. wegneri* and "*Ovis*" *kuhlmanni*, rather less than this in *O. boulei*, and about two

revolutions in *O. atropatenes*. The horn-cores of the two new species are almost circular in cross-section like those of *O. atropatenes*. In *O. boulei* and *O. wegneri*, they are quite circular, while in *O. rothii* they are more compressed laterally; in "*Ovis*" *kuhlmanni* extremely so. Those of *O. (?) mecquenemi* appear to resemble *O. rothii* in regard to their compression. The Mongolian horn-cores possess no trace of a definite keel nor of the external furrow which is so characteristic of *O. rothii*, and so resemble the horn-cores of *O. boulei* and possibly of *O. (?) mecquenemi* more nearly. All the other species have two or three well marked keels. In comparison

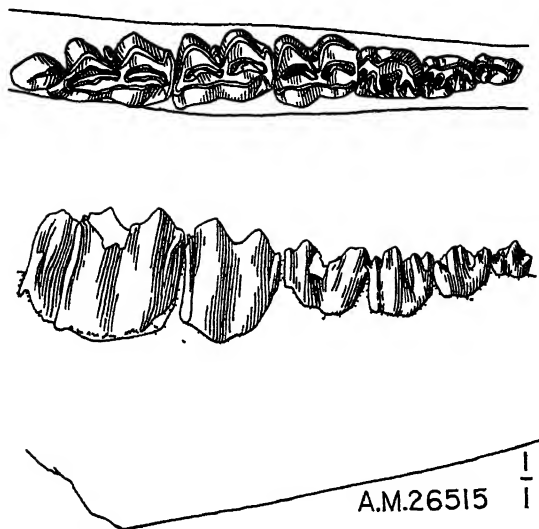


Fig. 12. *Oioceros (?) noverca*, new species, A. M. No. 26515, paratype. Left mandibular ramus showing crown and inner views of cheek teeth. Natural size.

with their length the Mongolian horn-cores are rather robust, though much less so than in *O. wegneri*. Relatively to the size of the skull, the diameter of the horn-core at the base is greater than in *O. boulei* and *O. atropatenes* but less than in *O. rothii* and *O. (?) mecquenemi* and much less than in "*Ovis*" *kuhlmanni*. The long pedicles of the horn-cores in the Mongolian species are very characteristic. No other species of *Oioceros* has them equally developed. The position of the supraorbital foramina at their base is not unlike a specimen of *O. rothii* from Maragha figured by De Mecquenem (1925, Pl. VII, fig. 4). The distance apart of the horn-cores at their base is relatively greater than in the other species and is to

be correlated with the greater width at the orbits. This distinction appears to be less marked in *O. atropatenes* and *O. boulei*; while on the contrary it is much more emphasized in "*Ovis*" *kuhlmanni*; and in *O. wegneri* the bases of the horn-cores are almost in contact. In the case of the two last-named species, the large size of the horn-cores accounts mainly for this. The general divergence of the horn-cores is similar in the Mongolian species and in *O. rothii* and *O. boulei*, but it is much greater in *O. wegneri*, "*Ovis*" *kuhlmanni*, *O. (?) mecquenemi* and apparently also in *O. atropatenes*. One of the most striking features of the Mongolian horn-cores is their uprightness. In most other species of *Oioceros* and in "*Ovis*" *kuhlmanni*, the horn-cores are tilted backward almost in the plane of the face. In *O. (?) grangeri* on the contrary the axis of the horn-cores forms an angle of no less than 55° with the facial axis and more than this in *O. (?) noverca*. In *O. rothii* and *O. atropatenes* they somewhat approach the condition found in the Mongolian species, the same angle being from 40° to 45° . This character seems to be a primitive one if we may judge by the uprightness of the horn-cores in the small antelopes of the Middle Miocene from Sansan. In both *O. wegneri* and "*Ovis*" *kuhlmanni* the horn-cores are situated quite behind the orbits. This position does not occur in the Mongolian species and apparently not in the other known species of *Oioceros*.

Although a long face seems, generally speaking, to be characteristic of the group, yet its length relative to that of the occiput is apparently greater in the Mongolian species than in most of the other species of *Oioceros*, with the exception of *O. (?) proaries* and "*Ovis*" *kuhlmanni*. In *O. wegneri* the face is also rather long. The defective character of most of the specimens prevents the ratio from being determined exactly, but *O. (?) mecquenemi* and *O. boulei* appear to have a much shorter face than any of the above-mentioned species.

Generally length of face is associated with long nasals and premaxillae, but the shortness of the occiput naturally affects the above ratio. In *O. boulei* the posterior end of the nasals lies just in front of the mid-point of the orbit, and their anterior end is far in front of P^2 . In *O. (?) mecquenemi* and *O. (?) grangeri* the posterior end of the nasals is on a level with or in front of the anterior edge of the orbits. In *O. (?) grangeri* at any rate, the nasals terminate at least as far in front of P^2 as in *O. boulei*.

In *O. boulei* the nasals articulate with both lacrymals and maxillae, but whether the premaxillae run up into the opening which is left between the maxillae and the nasals as in *O. (?) grangeri*, *Capra* and to

some extent *Ovis*, or are very remote from the nasals as in *Capricornis* and *Nemorhaedus*, the imperfect preservation of the specimens does not permit us to say.

The angle between the cranial and facial axes varies considerably in the different species. It seems to be least in *O. boulei*, about 20°. In *O. (?) grangeri* it is about 30°; in *O. rothii* about 40°; in *O. (?) mecquenemi* about 45°; in *O. (?) proaries* about 50°; in *O. wegneri* and "*Ovis*" *kuhlmanni* about 90°.

Most of the species of *Oioceros*, in which the lachrymal fossa is preserved, have it deep. It is certainly so in *O. boulei*, *O. (?) mecquenemi* and "*Ovis*" *kuhlmanni*, and is probably but little deeper in the Mongolian species, though its anterior extension may be greater than in the first two species named. In *O. wegneri* the lachrymal fossa is said to be large but shallow.

The position of the fronto-parietal suture is different in *O. (?) grangeri* from what is the case in *O. (?) proaries* and probably "*Ovis*" *kuhlmanni*. In the Mongolian species it lies far forward as in *Nemorhaedus*; in the Samos species considerably to the rear, as in *Ovis*. It is impossible to infer what obtains in other species of *Oioceros* from the figures, descriptions or specimens which I have seen. The swelling round this suture is a feature of the Mongolian species which, so far as I am aware, does not exist in other species of *Oioceros*.

In the group we are considering, the occiput is known only in the species *O. wegneri*, *O. (?) proaries*, "*Ovis*" *kuhlmanni* and *O. (?) mecquenemi* in addition to *O. (?) grangeri* and *O. (?) neverca*. It is very decidedly longer in the two Mongolian species than in any of the others. The small area of the surface of the occipital is a marked feature of *O. (?) proaries* and "*Ovis*" *kuhlmanni*. In the other species named it is larger. In *O. (?) mecquenemi* largest of all. In none of the European and Maragha species do we find the extraordinary concavity of the occipital surface nor the extreme prominence of the lambdoid crest, which are so remarkable in the Mongolian species. As might be expected, in *O. wegneri*, "*Ovis*" *kuhlmanni* and *O. (?) proaries*, in which the bending down of the face on the occiput is considerable, the angle between the occipital and the parietal surface is very obtuse, but even in *O. (?) mecquenemi* the angle is much more obtuse than in *O. (?) grangeri*. In the Maragha species the foramen magnum and the condyles also appear to be larger.

I am not aware of the structure of the basicranium in any other species of *Oioceros* except *O. (?) grangeri* and *O. (?) mecquenemi*. In both of these the basioccipital is very similar, somewhat less triangular

in the Maragha than in the Mongolian species, but in any case very different from the quadrate shape of *Ovis* and *Capra*. In both species the posterior tuberosities are low and laterally expanded, but the median groove between them is deeper in *O. (?) mecquenemi* than in *O. (?) grangeri*. The anterior tuberosities are low but more expanded laterally in *O. (?) mecquenemi* than in *O. (?) grangeri*. The bullae are broken off in *O. (?) mecquenemi* but their outline seems to be similar to that in *O. (?) grangeri*, though they may have been somewhat longer. I do not think they can have extended far below the general surface of the basi-occipital.

The upper molars agree in all the species referred to *Oioceros* in respect to their quadrate outline and relative hypsodonty. Relative to the dimensions of the skull, the size of the molars is greater in the Mongolian than in other species of *Oioceros*. On the other hand, the premolar series is shorter. This is less noticeable in *O. (?) noverca*. In *O. wegnéri* in particular, the premolar series is longer. P_4 is very similar in the species *O. boulei* and *O. (?) grangeri*. In neither case is the inner cusp united to the anterior and posterior wings, and the wings themselves are not at all complicated. In both there is a very deep furrow in the front third of the external wall of the tooth.

It remains now to compare the Mongolian skulls with those of various living forms, with the object of determining their most probable affinities.

The only genera besides the *Oiocerines* which regularly show a counter-clockwise torsion in the horn-cores are *Ovis*, *Pseudois*, and *Ammotragus*. In *Capra* the horn-cores are sometimes twisted, but generally in a clockwise direction. The expansion of the orbital roof is shown equally by *Ovis* and *Rupicapra*. It is less marked in *Capra* and still less so in *Myotragus balearicus* and *Nemorhaedus*, while in *Capricornis* the orbital rims do not project at all. At the same time the breadth at the frontals is extremely marked in *Capricornis*, though proportionately less so than in *Ovis*, *Rupicapra*, *Capra* and *Oioceros*.

The nasals in *Oioceros (?) grangeri* resemble *Ovis* rather than *Capricornis* and *Nemorhaedus* by their length, which is actually in excess of that usual in *Ovis*. On the other hand, their long articulation with the maxillae is like the condition in *Capra*, *Capricornis* and *Nemorhaedus*, but not like *Ovis*. The premaxillae, as in *Capra*, articulate both with the nasals and the maxillae. In *Ovis* there is a long articulation with the maxillae but none with the nasals, although the two bones are nearly in contact. In *Capricornis* and *Nemorhaedus* the premaxillae are very

remote from the nasals. The premaxillae exceed in length those of *Ovis*, *Capra*, *Capricornis* and *Nemorhaedus*, but in *Rupicapra* they are still longer. The fronto-nasal suture lies some way anterior to the orbits in *Ovis*, *Capra* and *Capricornis*. On the other hand, in *Oioceros* it is either on a level with or behind the anterior edge of the orbit. In *Rupicapra* its position is even more to the rear.

The position of the fronto-parietal suture in *O. (?) grangeri*, only 17 mm. behind the horn-cores, agrees nearly with that of *Capricornis* and *Nemorhaedus*. In *Capra* and *Ovis* it is much farther back, as is also the case in *Oioceros (?) proaries* and presumably in "*Ovis*" *kuhlmanni*. In consequence of the position of these two sutures, the frontals in *Ovis* are enormously long and the parietals short. Even in *Capricornis*, however, the frontals are longer than in *O. (?) grangeri* on account of the forward position of the fronto-nasal suture. *O. (?) grangeri* is midway between *Nemorhaedus* and *Ovis orientalis* in regard to the length of the frontals.

The course of the fronto-parietal suture, convex towards the rear, is different from that in any of the allied genera except *Rupicapra* and is in any case quite unlike that of *Ovis* in which the parietal indents the frontal at a right angle pointing towards the front.

The deep lachrymal fossa is paralleled in *Ovis*, but does not exist in *Pseudois*, *Ammotragus*, *Rupicapra* or *Capra*. A shallower one is found in *Capricornis*, while in *Nemorhaedus*, according to Pocock (1918, p. 135), although a fossa is not present, there is a small preorbital gland.

The basicranial region of *O. (?) grangeri* and *O. (?) mequeni* shows no resemblance to that of *Ovis* or *Capra*. In the living genera the basioccipital is broad and quadrate; the two anterior tuberosities are particularly strongly developed and laterally expanded, so that no interval is left between them and the bulla, and the basioccipital is actually wider in front than behind. In *Ovis* forward of this point, the basioccipital narrows abruptly, while at the same time the plane of its surface makes a definite angle with that of the basisphenoid. In *Capra* the basioccipital and the basisphenoid are in the same plane. In both genera the surface of the basioccipital is concave. In *Rupicapra* and *Oreamnus* the structure is very similar, though the anterior tuberosities are less prominent than in *Ovis*, so that the posterior portion of the basioccipital is the broader. On the contrary in *Oioceros (?) grangeri* the posterior tuberosities are strongly developed and a gradual narrowing occurs throughout the basioccipital and the basisphenoid, so that the shape is triangular. The anterior tuberosities are only slightly marked and the surface of the bone is convex. It is also much narrower and there

is a considerable interval between it and the bulla. The structure in most species of *Capricornis* and *Nemorhaedus* is almost identical with this, except that the basioccipital is rather broader especially in *Capricornis bubalina* which makes some approach to *Ovis*. In all these the bulla is small but most so in *Nemorhaedus*. In *Ovis* it is somewhat inflated. Its size and shape are very similar in *Oioceros*, *Capricornis* and *Pseudois*. *Oioceros* and *Pseudois* resemble one another most closely because of the size and shape of the vagina processus hyoidei, which is less wide than in *Ovis* and *Capricornis*. The small cleft in the inner wall of the bulla, which is visible in all the living genera mentioned but less so in *Ovis* and *Rupicapra*, is unnoticeable in *Oioceros* (?) *grangeri*. The position of the stylomastoid foramen and the foramen lacerum medium is more like the condition in *Capricornis* than in any of the other living genera. The foramen lacerum medium faces almost entirely downward instead of laterally.

The breadth of the occiput is relatively greater than in any of the living genera mentioned, but the difference is much less marked in the case of *Capricornis*.

Finally as to the dentition, the resemblance of *Oioceros* is to *Capricornis* and *Nemorhaedus* rather than to *Ovis* and *Capra*. The two former genera have square upper molars characterized by only a moderate degree of hypsodonty, in distinction from the narrow, strongly hypsodont upper molars of the two latter genera.

TAXONOMICAL CONCLUSIONS

It is evident that the nearest affinities to *Oioceros* (?) *grangeri* and the other *Oiocerines* are found in *Ovis* and its allies, *Capra*, *Rupicapra*, *Nemorhaedus* and *Capricornis*. Of these, *Ovis* and *Capra* are considerably more specialized than any of the others, on account of the extreme bending down of the face on the occiput, their large, twisted, complicated horns, the lateral expansion and hollowed surface of the basioccipital, the broad, high forehead, the large orbits, and the narrow, extremely hypsodont molars. So generalized are *Nemorhaedus* and *Capricornis* in most of these features that one could easily imagine some small, primitive, marginal species of one of these genera as the ancestor of both *Capra* and *Ovis*. At first sight it would seem that *Oioceros* (?) *grangeri* or *O. noverca*, which already possess the highly characteristic counter-clockwise torsion of the horns, might be the actual ancestor of *Ovis*, provided we can admit that the narrow, convex, triangular basioccipital of *Oioceros* (?) *grangeri* could, between the Sarmato-Pontian and the

Measurements of Species of Oiocerinae in Millimeters

MEASUREMENTS OF SKULL	<i>Oioceros (?) grangeri</i> , sp. nov.			<i>Oioceros (?) novaeae</i> , sp. nov.			<i>O. rothi</i> (Pikermi)	<i>O. atropatensis</i> (Maragha)	<i>O. boulei</i> (Maragha)	<i>O. wegneri</i> (Samos)	<i>O. (?) prouti</i> (Samos)	<i>"Ovis" kuhlmanni</i> (Samos)	<i>O. (?) megueneri</i> , sp. nov. (Maragha)
	A. M. 26508	A. M. 26509	A. M. 26510	A. M. 26223	A. M. 26501	A. M. 26507							
Length from occipital condyles to front edge of premaxillae.....	277												
Length from occipital condyles to front tip of nasals.....	203												
Distance from occipital condyles to hinder edge of orbit.....	100				77?						180		761
Distance from occipital crest to fronto-parietal suture.....	78										37?		743
Distance from fronto-parietal suture to fronto-nasal suture...	76								38		70?		761
Distance from midpoint of orbit to occipital crest.....	app.	102							49		780		80
Length of nasals.....	98												
Length of premaxilla.....	100												
Breadth of skull between external auditory meati.....	91				70		app. 95			75	63?		66
Breadth of skull at orbits.....	125.5	123			100				71	117?	86?	110?	791
Breadth of skull behind orbits...	62								746	71	59	67	
Breadth of skull behind fronto-parietal suture.....	73	70							45		62		63

Breadth of palate between P ²	37	40						16	24	22	25	31
Breadth of palate between M ³ ...	40							24	36	34	34	
Height of occipital from occipital condyles to top of occipital crest.....	62		46.5						42	36	37-40	42
Height of face in front of P ²	83							27	61	56?	67	745
Height of face behind M ³								38	48			48
Distance between outer edges of occipital condyles.....	52.5		38									730
Distance between supraorbital pits.....	53		37.5			36		24				
Vertical diameter of orbit.....	38	39						27	42			
Horizontal diameter of orbit.....	41							29	43			
Length of horn-core from top of pedicle to tip.....	110				145	145	106	?105	220?			
Longitudinal diameter of horn-core at base.....	39	32	26		31	29.5	20-21	20	52		53	?29
Transverse diameter of horn-core at base.....	35		26		26	22.5	17-18	20	51		38	?21
Distance apart of horn-cores at base of pedicles.....	28		18		23	19		19	25		18	?28
Distance apart of horn-cores at nearest approach.....	26		10		20?	19		18				
Distance apart of horn-cores at summit.....	92		34			117						
Angle between cranial and facial axes.....	30°	25°				740°	742°	20°	90°	50°	90°	45°
Angle between direction of horn-core and plane of face.....	55°					744°	40°	16°	20°?		0°	15°
Length of upper molar series.....	58	55			65°			27	39.5	42	39?	36
Length of upper premolar series.....	33	33			39			18	27	28	26.5	
(Antero-posterior diameter ..	19		19		24			11	15	15	14?	12.5
M ³ Transverse diameter.....	18		18					9	13	15.5	13.5	12
Height of crown (almost unworn).....			19					11+		15		

MEASUREMENTS OF MANDIBLE

	<i>Oioceros</i> (?) <i>grangeri</i> , A. M. 26516	<i>Oioceros</i> (?) <i>noverca</i> , A. M. 26515
Length from angle to front edge of incisors.....	225 app.	
Length from posterior end of M ₃ to front edge of incisors.....	162	
Length of diastema between P ₂ and canine.....	60	
Length of lower molar series....	57	44 5
Length of lower premolar series..	29	22
Depth of ramus below M ₃	35	
Thickness of ramus below M ₃	17	12
Height of crown of M ₃ (inside)...	21 +	19

Pleistocene, have assumed the broad, concave. quadrate shape, which characterizes the basioccipital of *Ovis*. However unlikely it might be thought that a change so important and one which affects such a particularly stable part of the anatomy should occur within that short period, one would not be prepared altogether to deny its possibility, were it not for another consideration which militates against the ancestry suggested. Both *Capra* and *Ovis* possess essentially the same type of basioccipital, but the horns of *Capra*, if untwisted, generally have a clockwise and those of *Ovis* a counter-clockwise torsion. Occasional exceptions, such as occur in *Capra pyrenaica* and *C. caucasica*, do not invalidate the following argument, since by a small heritable mutation an untwisted horn may develop torsion in either direction. One can scarcely imagine that this type of basioccipital arose independently on the two lineages of *Capra* and *Ovis*. Still less is it conceivable that the counter-clockwise-twisted horn of *Oioceros* (?) *grangeri* should have changed into the clockwise-twisted horn of *Capra*. It follows that the Ovicaprine type of basicranium must have been in existence contemporaneously or at any rate little later than the epoch at which *Oioceros* (?) *grangeri* lived and that the latter species represents a lineage which independently of *Ovis* developed a counter-clockwise torsion of the horns either at the same time or perhaps precociously. In the circumstances, unless we place *Ovis*, *Capra*, *Rupicapra*, *Nemorhaedus*, *Capricornis*, *Myotragus*, *Oioceros*, *Budorcas*, *Ovibos* (according to Pocock, 1918, p. 140) and their allies in one and the same subfamily, (a procedure which indeed I favor, though it is contrary to custom), we seem compelled to regard *Oioceros* (?)

grangeri and *O. noverca* as representatives of a distinct subfamily, *Oiocerinae*. *Rupicapra*, with its Ovine basicranium, upright, primitive horns, narrow muzzle and backwardly placed nasals, should equally be separated as a subfamily distinct from *Nemorhaedus* and *Capricornis*. Pocock (1918, p. 140) has already advocated this for *Rupicapra* and makes yet another subfamily for *Budorcas*. As regards the other six species which have been referred to *Oioceros*, as well as "*Ovis*" *kuhlmanni*, the similarity of the basicranium of *O. (?) mecuqueni* to that of *O. (?) grangeri* affords good evidence of genetic affinity between these two, but until we become acquainted with the basicranium of the others, we are not in a position definitely to say whether all or any of them belong to the lineage of *Oioceros (?) grangeri* and *O. noverca* or to that of *Ovis*. Certain characters possessed by *Oioceros (?) proaries* and "*Ovis*" *kuhlmanni* seem more suggestive of an Ovine ancestry, in particular the backward position of the fronto-parietal suture, the large orbits, the large horns and the small occiput. On the other hand, the forward extension of the nasals and the quadrate upper molars point to an affinity with *Oioceros (?) grangeri*. I am, however, predisposed in favor of regarding them all as of the same lineage on account of the fact that so many species with counter-clockwise-twisted horns and having teeth and other characters at the *Nemorhaedus* stage of evolution lived at about the same geological epoch in Eurasia. Otherwise it is curious that we find no developmental stages between say "*Ovis*" *kuhlmanni* and true *Ovis* in the same Eurasiatic region, indeed that *Ovis* is entirely absent previous to the Pleistocene in spite of numerous finds of fossil antelopes in the Val d'Arno, Rousillon and S  n  ze. The latter locality has even yielded a whole skeleton of *Nemorhaedus philisi* Schaub (1922, p. 558). If *Ovis* and *Capra* had sprung from some *Nemorhaedus*-like form either in another region or at a later epoch, this anomaly would disappear and we should merely regard the *Oiocerines*, including "*Ovis*" *kuhlmanni*, as a special group, which developed in many ways similarly to the sheep and goats but did not persist beyond the Pontian.

In conclusion I wish to express my thanks to Mr. E. H. Colbert and to Mrs. Margaret Colbert for the execution of the composite diagram of *Oioceros (?) grangeri* on page 8, and to the former for his kindness in measuring several specimens in the American Museum for me; also to Mr. and Mrs. John Germann for the drawings of teeth and the retouching of several of the photographs.

Comparative Ratios in Genera Allied to *Oioceros*

	<i>Oioceros grangeri</i>	<i>Oioceros boulei</i>	<i>Ovis orientalis</i>	<i>Capricornis sumatrensis</i>	<i>Nemorhaedus griseus</i>	<i>Rupicapra rupicapra</i>	<i>Capra walia</i>
<u>Hinder edge of orbit to tip of premaxilla</u>	$\frac{205}{97} = 2.11$		$\frac{184}{87} = 2.11$	$\frac{198}{108} = 1.83$	$\frac{163}{88} = 1.85$	$\frac{156}{59} = 2.64$	$\frac{177}{97} = 1.82$
<u>Hinder edge of orbit to occipital condyles</u>							
<u>Hinder edge of orbit to tip of premaxilla</u>	$\frac{205}{70} = 2.93$		$\frac{184}{72} = 2.55$	$\frac{198}{74} = 2.67$	$\frac{163}{71} = 2.30$	$\frac{156}{62} = 2.39$	$\frac{177}{76} = 2.33$
<u>Breadth of skull behind fronto-parietal suture</u>							
<u>p² to tip of premaxilla</u>	$\frac{83}{70} = 1.18$		$\frac{66}{72} = .91$	$\frac{89}{74} = 1.20$	$\frac{59}{71} = .83$		$\frac{65}{76} = .85$
<u>Breadth of skull behind fronto-parietal suture</u>							
<u>Length of nasals</u>	$\frac{98}{70} = 1.40$	$\frac{49}{45} = 1.09$	$\frac{96}{72} = 1.33$	$\frac{93}{74} = 1.26$	$\frac{82}{71} = 1.16$	$\frac{74}{62} = 1.20$	$\frac{90}{76} = 1.20$
<u>Breadth of skull behind fronto-parietal suture</u>							
<u>Length of premaxilla</u>	$\frac{100}{70} = 1.43$		$\frac{94}{72} = 1.30$	$\frac{83}{74} = 1.12$	$\frac{74}{71} = 1.04$	$\frac{156}{62} = 2.39$	
<u>Breadth of skull behind fronto-parietal suture</u>							

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AMBICOLORATION IN THE WINTER FLOUNDER, *PSEUDOPLEURONECTES AMERICANUS*

- I.—INCOMPLETE AMBICOLORATION WITHOUT OTHER DEFORMITY
II.—COMPLETE AMBICOLORATION WITH A HOOKED DORSAL FIN
AND WITH THE ROTATING EYE JUST OVER THE DORSAL RIDGE

By E. W. GUDGER

INTRODUCTION

The Pleuronectidae or flatfishes are normal abnormal forms. They are abnormal because instead of standing vertically in the water with the upper half of the body dark and the lower light, they lie on one side which is white and blind, while the upper side is colored and double-eyed. If only an occasional such specimen were found, it would be reckoned the greatest possible abnormal fish. But, since the flatfishes are among the commonest of our littoral forms and since all normally correspond to the specifications above, no one ever thinks of them as abnormalities. However, they are teratological fishes which in their own group are entirely normal. This is a point that has never been particularly emphasized.

Flatfishes normally lie on one particular side (right or left according to genus and species) and have eyes and color on the other, except chiefly the flounders (the little specialized forms) with which it is almost a matter of indifference. Any departures from these normal characters constitute such a specimen an abnormal pleuronectid. These departures are of two kinds: (1) the lying on the wrong side (i.e., on the right side when the left is the rule for the genus) with eyes and color on the wrong side; or (2) while lying on the normal side, having color or the absence of it on the wrong side, with or without an abnormally placed rotating eye and a hooked dorsal fin, or both. Flatfishes of the first kind are called "reversed" fishes, and those having color on the under side are known as "ambicolorate" or double colored (i.e., colored on both sides).

There are in the collections of the Department of Ichthyology of the American Museum two undescribed specimens of our common winter flounder: one having simple or uncomplicated ambicoloration on the under side, the other almost wholly dark below and having the rotating eye stopped just across the dorsal ridge and overhung by the anterior hooked end of the dorsal fin.

About such flatfish abnormalities a considerable literature has arisen in western Europe, but only two distinctive articles and four incidental notices on such anomalies in American forms have been published. Hence it may be of interest and value to figure, describe, and briefly discuss our two specimens.

Furthermore, this article will serve as an appropriate introduction to two others on these abnormal fishes on which I have been engaged for nearly a year. In these will be brought together all the data known on ambicoloration without or with other anomalies. The subject is vast and at present in a most chaotic condition, but in these articles I hope

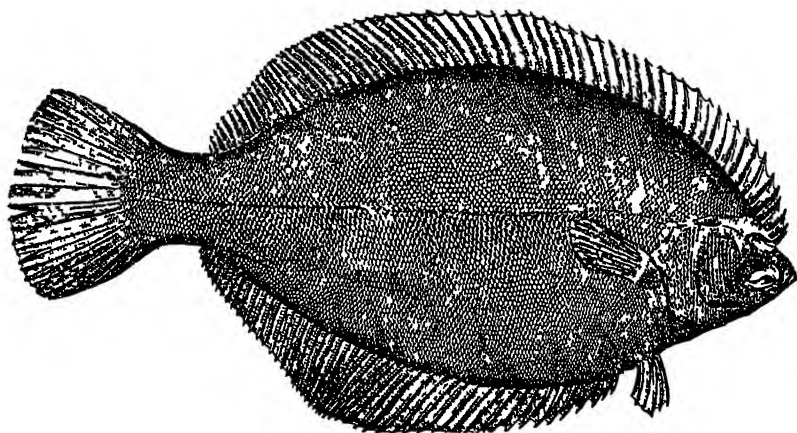


Fig. 1. Upper surface of a normal winter flounder, *Pseudopleuronectes americanus*.
After Jordan and Evermann, 1900.

to bring the data into order and to show how increasing ambicoloration is accompanied in extreme forms by eye and fin anomalies, and to work out in such forms a definite gradation from the simplest to the most complicated abnormalities. This has never been undertaken before.

However, before taking up the abnormal forms, it will be well to present as figure 1 a drawing of the upper or right surface of a normal *Pseudopleuronectes americanus*. This is copied from Jordan and Evermann's 'Fishes of North and Middle America,' Washington, 1900, volume IV, Pl. ccclxxix, fig. 933. From this figure it will be clear why I have emphasized the fact that a flatfish is a normal teratological fish. From this normal specimen let us now proceed to the teratological forms.

I.—A SIMPLE OR INCOMPLETELY AMBICOLORATE

Pseudopleuronectes americanus

This specimen was found in a small fish market at Seventy-fifth Street and Broadway, New York City, in July, 1931, by Mr. Charles R. Knight, the well known animal painter. Recognizing the interesting abnormality, he purchased the fish, and kindly presented it to the Museum. Presumably this specimen came from the waters around New York, where the species is abundant. Its range is from Labrador to Virginia, and sparingly as a straggler farther south. This specimen measures 14 in. to the base of the caudal fin (standard length) and 17 in. over all. Its depth is 5.75 in. and its weight is 1.5 lbs. It is then an adult.

On the upper or right-hand surface of this ambicolorate specimen there is nothing abnormal to be seen. The eyes are in their usual position, there is no notch at the point where the dorsal meets the head, and the lateral line ends under the fourth dorsal spine. The fish might have been the normal one from which the upper aspect figured in Jordan and Evermann's plate was drawn. It must be emphasized then that in the ordinary ambicolorate flatfish, there is nothing on the upper surface to indicate that such a fish is in any wise abnormal.

When, however, one turns to the lower or left surface an entirely different situation is presented. The fish was in bad state before preservation—the scales and epidermis being partly gone from both surfaces and the viscera removed. However, in general, the two sides are alike dark in color, with the following exception: the whole under surface of head and operculum is white, as is also the whole shoulder region above and behind the head and the operculum and the left pectoral fin; this white region or patch extends backward to the 17th dorsal ray and then is delimited from the posterior dark area by an irregular line extending downward to and under the hinder part of the pectoral fin. The region immediately above and behind the base of the fin is dark. This is shown clearly in figure 2.

Other than this white head, operculum, and shoulder region, the whole lower surface is as dark as the upper, but there are no other abnormalities save a fragment of what appears to be lateral line on the head just below the nostril. The lateral line proper ends under the sixth dorsal spine and there are neither spines nor rough scales on the under side such as have been noted on other ambicolorate specimens. The left eye has been carried clear across the mid-dorsal line onto the right surface of the head, to its normal position as seen in figure 1, and is not visible from below.

Other known reports of abnormalities of *Pseudopleuronectes americanus* are but three. It is stated (Anon. 1901) on the authority of the late Vinal N. Edwards that in February, 1900, he obtained a reversed specimen, the only one in his long years of collecting at Woods Hole. H. C. Bumpus is also quoted (1898) as reporting that in the winter of 1898-1899 great numbers of "black bellies" (i.e., piebald on lower side)

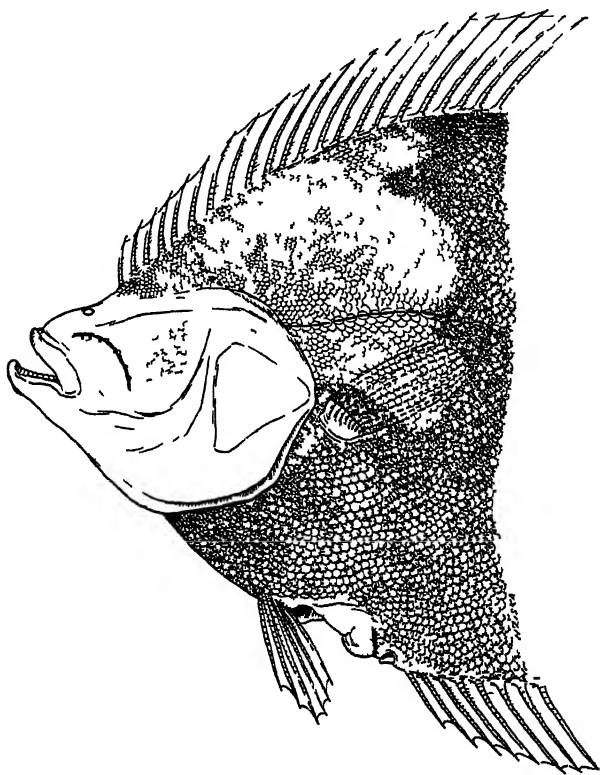


Fig. 2. Lower or blind surface of an incompletely ambicolorate winter flounder in the collections of the American Museum.

were taken in Greenwich Bay, Rhode Island, and that in 1900 a few 7 and 8-in. specimens were taken at Waquoit. V. N. Edwards reported that these were the first abnormally colored winter flounders he had seen in thirty years seining there. From this one must conclude that this flounder is little given to variation.

So far as I know, there are only two other references to simple ambicolorate American pleuronectids (but not winter flounders). Hus-

sakof, in 1914, described two incompletely ambicolorate specimens of the summer flounder, *Paralichthys dentatus*, from Cape Lookout, North Carolina. And in 1921, Banta described a number of young unidentified flatfish from Cold Spring Harbor, north shore of Long Island. Consideration of all these specimens will be given in the first of the two general papers on ambicolorate flatfishes on which I am now at work.

II.—COMPLETE AMBICOLORATION WITH A HOOKED DORSAL FIN AND WITH THE ROTATING EYE JUST OVER THE DORSAL RIDGE

The interesting specimen now to be studied came to my attention through the kind offices of Mr. J. A. Weber of New York City, and was presented to the Museum by its captor, Mr. Emile Klee, also of New York City.

On April 14, 1931, while fishing in Goose Creek, Jamaica Bay, Long Island, with hook and line and using a sandworm for bait, Mr. Klee caught the fish under consideration. When brought in, its captor at first noticed nothing unusual about the fish, but on turning it over he found the lower surface dark instead of white. Then the hooked front end of the dorsal fin attracted his attention. He had never seen such a flounder in all his thirty-five years' experience as a fisherman, so he called his companions to examine it and, in his own words, "to see whether there was something wrong with my eyes or with the fish."

This is a small specimen of the common winter flounder, measuring 7.5 in. long to the base of the caudal and 9.25 in. over all. Its depth is 3.4 in., and its weight 4.75 oz. This is, then, a young fish, probably about three years old.

This fish is abnormal in four respects: it is ambicolorate—the lower surface is colored like the upper side; the left eye was arrested in its rotation just after it crossed the dorsal crest; it has the hooked dorsal fin often associated with these other anomalies; and lastly, there are certain abnormal branches of the anterior end of each lateral line.

The normal color is dull brown above and white below. Our specimen had had most of the scales removed from both sides of the body before it was presented to the Museum, but being in good condition it is clear upon examination that its color was that common to the species. The whole lower surface is of exactly the same color as the upper save that the anterior half of the head lacks pigment (Fig. 4). How white it was in life cannot be said, since it was brought to me in formalin, but at the present time this patch is yellowish white. The scales were not removed from head and shoulders and hence show in the drawings—

figure 3, from the right or upper surface, and figure 4, from the left or lower side, showing the white patch.

The upper or right surface presents two abnormalities in the head region. Most apparent is the fact that the left eye has not rotated wholly to the right side, as is shown in figure 3. The left-hand rim of the eye lies in the mid-dorsal region, and this edge (but not the pupil) is visible when one looks at the fish from the left side, as may be seen in figure 4. Of equal interest is the abnormal dorsal fin—with a notch at its anterior base. This notched fin overhangs the hinder edge of the left rim of the eye.

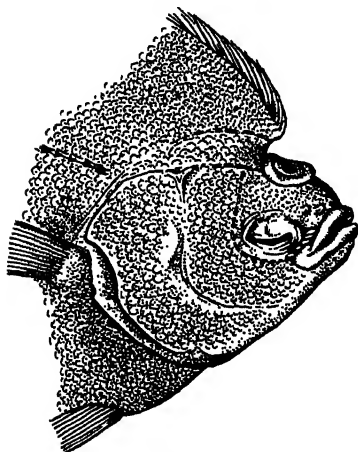


Fig. 3

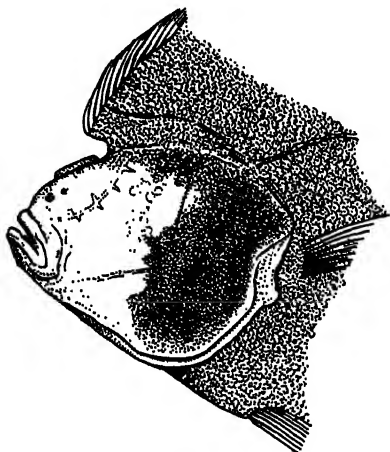


Fig. 4

Fig. 3. Upper surface of the head of a practically ambicolorate winter flounder in the collections of the American Museum, to show the incompletely rotated eye and the hooked dorsal fin.

Fig. 4. Lower head region of the same specimen.

The other abnormality is to be found in the anterior end of the right lateral line. At the upper hinder edge of the operculum the lateral line divides. The upper branch arches up slightly and runs forward to the base of the dorsal fin. The other curves around the upper limit of the opercular region, then swings down behind and underneath the right eye and ends behind and on a level with the opening of the mouth.

On the under or left surface, as shown in figure 4, it is seen that the anterior half of the head and opercular region are white. The hinder half (in a rough semicircle) is darker even than the remainder of the lower side of the fish. At the edge of the upper limit of the white area,

the left edge of the left eye may be seen. On the left side as on the right, the lateral line shows some abnormalities. After making the same gentle curve over the base of the pectoral fin, at the same spot as on the right side (as ascertained by driving a pin through the head), the lateral line curves upward and forward to end under the base of the fourth dorsal fin ray. I am unable to make out a lower branch of the lateral line as on the right side, but on the upper part of the white area there is a curious structure with blunt lateral outpushings which I interpret as a malformed section of the lower branch of the lateral line. This recalls a similar fragment on the under side of the head of the first fish—see figure 2. Diagonally behind and below this is a patch of curious structures which I take to be the bases of abortive scales. There are no scales present, these are impressions in the integument.

The most marked abnormality of all is of course the hooked dorsal. This seems to have been the result of the incomplete translation of the left eye to the right side. The disturbances connected with this have also probably had much to do with the abnormalities of the lateral line. Furthermore, this hooked dorsal seems tied up closely with the degree and extent of the pigmentation of the under or left surface.

Comparison should be made, at this point, of the large amount of pigment on the under side of the head of fish No. II, with the sparse amount on that of No. I. Not only is the whole lower body of fish No. II as darkly and densely pigmented as the upper surface, but practically all the opercular region (except the outer hinder and lower edges) is heavily pigmented, also the upper part of the head; the median ridge and the lower jaw are slightly pigmented. Fish No. I (Fig. 2) not only has head and operculum but also the whole shoulder region colorless. No. II has the eye and dorsal fin anomalies which go with extreme ambicoloration, while in these organs No. I is as normal as a white-bellied fish.

There are in the literature known to me but two references (both incidental) of such abnormalities in American pleuronectids as those described above for fish No. II. As early as 1815, Mitchell incidentally described an abnormal "black-bellied" flounder, which he appropriately (as he thought) named *Pleuronectes melanogaster* (probably *Paralichthys dentatus*). This has "the belly . . . almost as dark colored as the back; the hue—a shade lighter." The rotating eye was barely over the dorsal ridge and the dorsal fin was hooked in front. His specimen then was practically a duplicate of mine.

Lastly, Storer (1844) described an ambicolorate *Platessa oblonga* (*Paralichthys lethostigmus*?) colored on both sides. The rotating eye

was "directly on top of the head," and the dorsal fin was hooked. This was not only described but figured in his paper of 1863, and in his book of 1868. This fish and that described by Mitchill will be considered again and more fully in the second paper in progress—i.e., that on complete ambicoloration.

It does not seem well in this short paper to discuss the amount and the cause of ambicoloration in flatfishes, nor to endeavor to find an explanation for the abnormally placed eye and for the hooked dorsal fin. We must first have under our feet all the known facts. For simple ambicoloration, these facts will, in all cases known to me, be brought together in the first of the papers on which I am engaged, in an effort to ascertain how far forward the dark color may advance on the under side without any head abnormalities being found. Then all the causes alleged for this phenomenon will be discussed.

In the second paper, the far greater number of accounts dealing with complete ambicoloration and the accompanying head anomalies will be classified and studied, and then an endeavor will be made to explain the partly rotated eye and the hooked dorsal fin. This has proved to be an exceedingly difficult task, but there is some light ahead.

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AN APPARENTLY NEW FRUIT BAT OF THE *PTEROPUS* *HYPOMELANUS* GROUP FROM GOWER ISLAND, SOLOMON ISLANDS

By G. H. H. TATE

Pteropus goweri, new species

TYPE.—No. 87201, Amer. Mus. Nat. Hist.; ♂ ad.; Gower Island, Solomon Islands; September 19, 1930; collector, J. B. Riddall, Whitney South Sea Expedition. Skin and skull in good condition.

GENERAL CHARACTERS.—The "unmodified Pteropine" skull (Andersen) and short forearm (108–111 mm.) suffice to place *goweri* near *colonus*, *solomonis* and *howensis*.

Measurements (in millimeters) of *Pteropus goweri*.

	No. 87199 ♀	No. 87200 ♀	No. 87201 ♂ (type)	No. 87202 ♂	No. 87203 ♀
Forearm	111	110	108	.....	.....
Zygomatic width	28	28 3	31.3	31.4?	32.0
Width across canines	10.9	11.0	11.7	.....	11.5
Orbital diameter	10.9	11.3	11.7	.....	11.3
Mandibular length	41.2	40 8	43.2	43.7	42 1
C-m ²	20.1	20.0	22.1	21.3	20.4
C-m ₃	22.2	21.9	24.5	23.7	23.2
Length p ⁴	3.7	4.0	3.9	4.0	3.8
Length m ¹	4.5	4.8	4.8	4.6	4.6
Length m ²	1.8	1.8	1.8	1.8	1.7
Length m ₁	3.8	3.8	3.9	3.9	3.8
Length m ₂	3.1	3.2	3.0	3.1	3.0
Length m ₃	1.6	1.6	1.6	1.4	1.6

DESCRIPTION.—Texture and length of pelage about as in *howensis* and *colonus*. Length of hairs of back 10–12 mm., of mantle 12–15 mm. Tibia nearly naked. Color¹ of back Mars brown to Prout's brown, becoming slightly russet towards wing membranes; mantle near ochraceous orange paling to ochraceous buff posteriorly, and merging anteriorly with a grizzled mixture of clay-color and light ochraceous-buff. Neither mantle nor back in the type have more than a trace of dark bases to the

¹Colors are those of R. Ridgway, 1912, 'Color Standards and Color Nomenclature.'

hairs. Under surface with throat and abdomen mummy brown, the entire area of the chest, however, tawny, which anterior to the wings merges with the brighter color of the mantle. The inguinal region is also tawny.

Skull very close structurally to that of *howensis*, but with rostrum very slightly heavier.

Pteropus goweri is based upon a series of six specimens (2 ♂ ad., 3 ♀ ad., 1 ♀ juv.). The individuals of the series vary from the type as follows: the band of tawny across the chest may be narrowed antero-posteriorly (No. 87200, ♀); the hair tips of the crown of the head may be greatly whitened (No. 87199, ♀) or slightly so (No. 87203, ♀). In the juvenile ♀ (No. 87198) the mantle hue is already developed. Its color is near *argus* brown.

This bat may be distinguished from *colonus* by the color of the mantle and chest; from *howensis* by similar color differences coupled with shorter forearm; and from *admiralitatum* by the shorter forearm. It is smaller than any subspecies of *hypomelanus*.

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A NEW *GAMBUSIA* FROM ANDROS ISLAND, BAHAMAS

By C. M. BREDER, JR.

Gambusia manni Hubbs, known from both New Providence and Andros Island, appears to be absent from the southern part of the latter island. In its place there occurs another and similar form that may be described as follows.

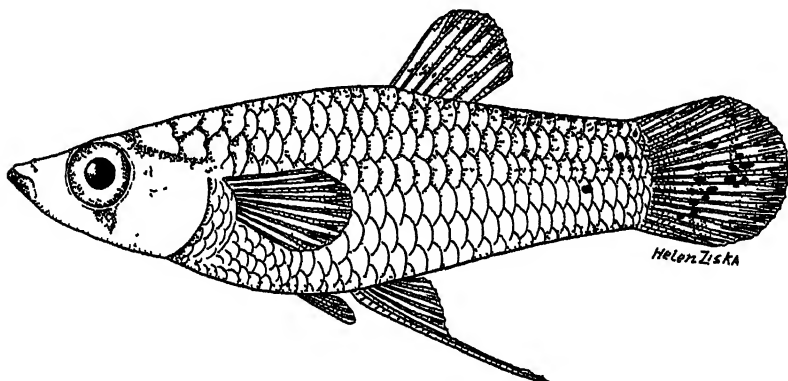


Fig. 1. *Gambusia hubbsi*, new species. Type, 30 mm. standard length.

Gambusia hubbsi, new species

TYPE.—No. 12454, American Museum of Natural History. Figure 1.

Standard length, 30 mm.; total length, 34.5. Head, 3.2; depth, 3.2; dorsal $7\frac{1}{2}$; anal, $8\frac{1}{2}$; scales, 27. Axis of body angulated as in *G. manni*, but body much compressed for a *Gambusia*. Caudal peduncle markedly compressed, 1.3 in head; head broad and flat; interorbital, 2.3; eye, 3.0; snout, 3.3; dorsal behind anal, midway between caudal base and gill opening. The gonopodium 3.0, equal to distance from snout to pectoral axil and falling short of caudal base by depth of body at its tip. The pectorals and pelvics coequal in reach, extending slightly beyond the origin of the anal; pectorals, 1.2; pelvics, 3.0. Otherwise, very similar to *Gambusia manni*. The edge of the spinule area of the third anal ray is markedly convex instead of nearly straight as in *G. manni*. Figure 2 illustrates the differences in this gonopodial character.

In alcohol the color is a light tan. The scale pockets are margined with dark except on the lower portions, which are silvery. There is no evident axial streak. The predorsal streak is distinct, merging into the dark upper portions of the head. There is no postgonopodial streak. The snout and chin are blackish. There is a conspicuous, oblique bar (backward and down) below the eye, and a narrow dark

horizontal line from the eye to dorsal termination of the gill cleft. There are a few irregular black punctations on the dorsal fin and somewhat more on the caudal. There are also a very few black specks on the sides. The spotting on the sides of the paratypes is for the most part greater than in the type, in some tending to arrange in lines.

In the females the body depth is greater than in the males, reaching as high as 3.1. The anal of the female is 1.5 in the head. The pectorals reach about halfway between the origin and tip of the pelvic; pectorals, 1.2; pelvics, 2.5. The pelvics reach the anal origin.

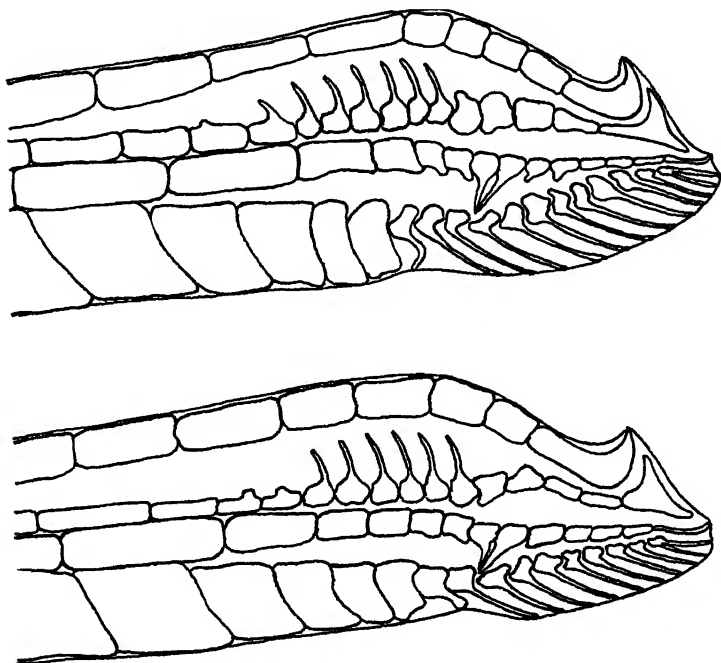


Fig. 2. Tips of gonapodia of *Gambusia*. Upper, *G. hubbsi*; lower, *G. manni*.

There are 68 paratypes (A. M. N. H. No. 12455), 10 of which are males. They range from 13 to 37 mm. with a mode of 27 (female) and from 16 to 30 mm. with a mode of 25 (male) in standard length.

The colors in life are distinctly more brilliant than those of *G. manni*. Chiefly, the fishes of both sexes are prominently a metallic bluish with a distinct metallic sheen. The writer has seen *G. manni* in its native haunts, from both north Andros and New Providence (Breder, 1932, 1933), and noted that the differences are so marked that these fishes can be distinguished at sight. The differences in behavior are also

well marked. *G. manni* on both islands was seen to be a rather timid little brownish fish, readily scattered and not easily caught, nor especially given to surface swimming as these fish go. *G. hubbsi*, on the other hand, could not be driven from the surface. They were consequently easily caught and the broken-up school immediately reassembled. These fish also swam up to and followed waders in a manner suggesting a considerable amount of curiosity. Lest it be thought that these differences were due to water or other conditions, it is pointed out that other fishes caught in company with them behaved the same on both north and south Andros. A full discussion of this will be given in a forthcoming report on the ecology of the region.

Dr. C. L. Hubbs, for whom I take pleasure in naming this fish, kindly compared some specimens with the extensive series of poeciliids in his charge at the University of Michigan. Consequently, I am able to make the following remarks, based on his findings.

The present form resembles the Jamaican *Gambusia oligosticta* Regan in the relatively large size of the head, and the Cuban *Gambusia puncticulata* Poey in the relatively moderate spotting. The *G. manni* from Lake Forsyth, Andros (Breder, 1932), resembles *G. hubbsi* somewhat more closely than do those from Lake Killarney, New Providence, but the former are small, the largest being 25 mm. s.l. and the mode 18.5. It would thus seem that Lake Forsyth is inhabited by a small form, although those in Lake Killarney were just about of the same size. Hubb's type of *G. manni* was 23.5 (Hubbs, 1927a), but he had females up to 50 and males to 30 mm. and they were, presumably, aquarium grown specimens. *G. hubbsi*, on the other hand, is a definitely larger fish than any *G. manni* seen by us. The latter is known also from several other islands in the Bahamas (Hubbs, 1927b); New Providence, Andros (except south Andros ?), Green Turtle Cay, and San Salvador.

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AN APPARENTLY NEW FAMILY OF AMBLYPOD MAMMALS FROM MONGOLIA¹

BY WALTER GRANGER AND WILLIAM K. GREGORY

The three incomplete fossil lower jaws and a last lower molar which are the subjects of this note were found by members of the Central Asiatic Expedition of 1925 and 1928 in the Shara Murun region of Inner Mongolia. By preliminary field and laboratory determinations they had been referred tentatively to the chalicotheres branch of the Perissodactyla, but later a direct comparison with the known Mongolian chalicotheres by Mr. Edwin H. Colbert revealed many significant differences that will be referred to later in this report. The tentative removal of these specimens from the chalicotheres initiated a series of rejections by different members of the departmental staff which progressively enhanced the interest and possible importance of these specimens. Dr. George Gaylord Simpson could recall no group among all the hosts of extinct South American ungulates in which the orphans could find a home; the present authors unanimously shut the gates of the known perissodactyls and then by systematic comparisons eliminated one family after another of artiodactyls. Nor did we neglect to consider even the insectivores and bats for analogies with the peculiar characters of the dentition revealed by the present specimens. It was not until we began to make comparisons with the Paleocene group of Taligrada, as represented especially by *Titanoides* and *Pantolambda*, that we noted resemblances to our specimens that had the appearance of being more than mere convergences or parallelism.

The conclusion that the specimens under consideration represent a family of mammals new to science may now be set forth.

In the first place we can be sure that we are dealing with a placental mammal of some sort from the fact that the dental formula: I_3, C_1, P_4, M_3 , is the classic primitive eutherian formula. Hence by even the most conservative application of the axiom of the irreversibility of evolution we may eliminate not only all pre-placental but also all those placental genera in which the dental formula has become either reduced or second-

¹Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 125.

arily increased beyond the primitive placental grade. Secondly, we can eliminate all forms that show advanced specialization of the dentition by the fact that in our specimens even the posterior premolars are still in

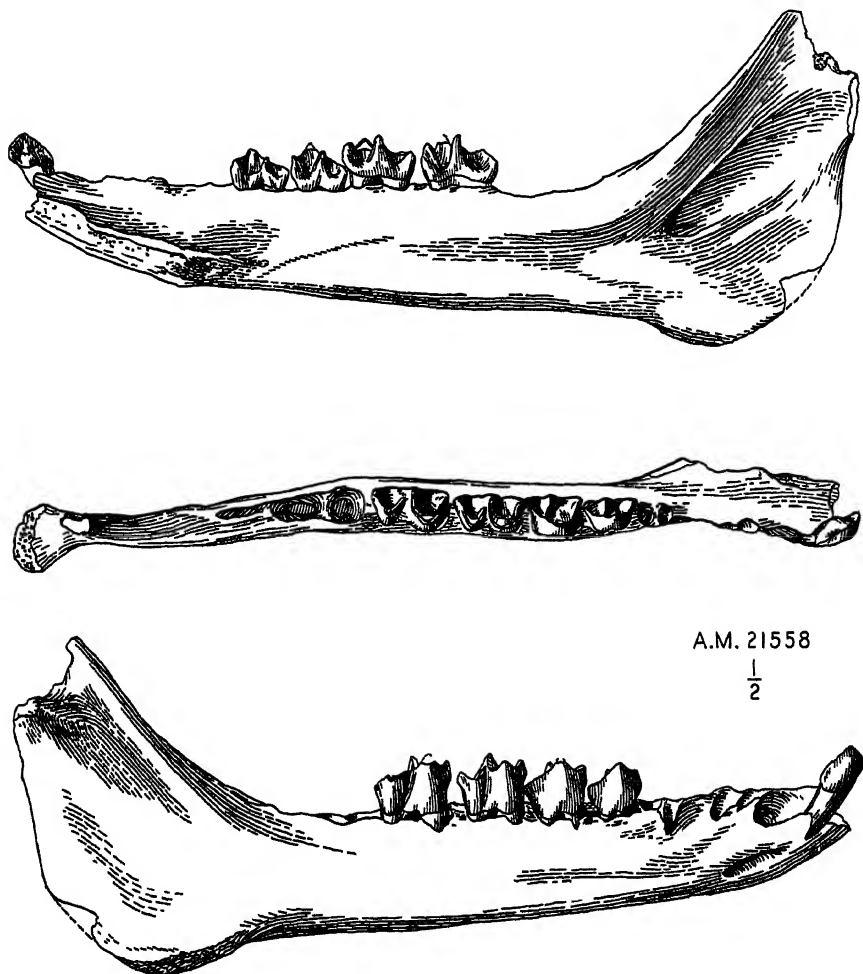


Fig. 1. *Pantolambdodon inermis*, gen. et sp. nov. Type, Amer. Mus. No. 21558. Theright ramus of the lower jaw: inner, superior and outer views. One-half natural size.

a relatively low stage of complication, while the molars, although advanced beyond the primitive tuberculo-sectorial stage, have not assumed any of the specializations that are characteristic of the various families of perissodactyls and artiodactyls, as will be shown in detail later.

Relationship with any of the more typical South American ungulates is eliminated by the absence in the present specimens of the various queer diagnostic characters of these heterodox non-conformists. For instance, the posterior V of the present forms lacks the isolated entoconid of many notoungulates, and there is no flattening or asymmetrical enlargement of the talonid ectoloph. *Trigonostylops*, as described by Simpson (Amer. Mus. Novitates No. 608, 1933) has wide diastemata on either side of P_1 and its molars have large talonids and more or less separate entoconids. *Palaeostylops*, a supposed relative of the notoungulates found in the Gashato Paleocene of Mongolia, has the excessively flattened talonid ectoloph on M_3 and distinct entoconid crest, which are conspicuously lacking in our specimens.¹ Among the litopterns the Macrauchenidae agree with our forms in the dental formula and in having completely W-shaped lower molar crowns, but differ radically in that the talonid is larger than the trigonid and the premolars are much more complex. The horse-like litopterns also have complex premolars and other striking specializations.

Our lower jaws differ from those of chalicotheres in that their premolars are all essentially of one pattern, with very small incipient talonid fossae, whereas in chalicotheres the talonid of P_4 is larger than the trigonid. In the molars also the talonids are much smaller than the trigonids, while in chalicotheres the talonids, at least on M_1 and M_2 , are somewhat larger than the trigonids. The diastemata, front teeth, and general shape of jaw are widely different.

It may be stated summarily that neither *Lambdaotherium* nor the true titanotheres² offer the slightest suggestion of relationship with the specimens in hand, and the same is true of all the tapirs, horses, rhinoceroses, etc., with lophodont molars of various kinds.

The artiodactyls present a more extensive problem, but after fairly wide comparisons we may eliminate at once all the bunodont pigs, peccaries and entelodonts and all the selenodonts high and low from *Anoplotherium* to *Xiphodon*, and from *Agriochoerus* to *Vishnutherium*. The reasons are that in the artiodactyls, even in the most primitive Lower Eocene dichobunids, the paraconids are absent or inconspicuous and the molar cusps are antiodont, that is, they are grouped in two pairs, the metaconid being directly internal to the protoconid and the entoconid to the hypoconid, whereas in the present specimens the lower molar

¹Matthew, W. D., Walter Granger, and George Gaylord Simpson, 1929. Amer. Mus. Novitates, No. 576, p. 1.

²Osborn, H. F. 1929. 'The Titanotheres of Ancient Wyoming, Dakota, and Nebraska.' Monograph 55, U. S. Geol. Surv.

cusps conform to the amoebodont pattern of Cope,¹ since the paraconid is elevated and the metaconid and entoconid lie well behind the proto- and hypoconids respectively. Moreover in the artiodactyls the talonid is at least not inferior in width to the trigonid, whereas in the present specimens the reverse is the case. Nor do the premolars of artiodactyls agree in details with those of the Mongolian jaws. Hence the vague

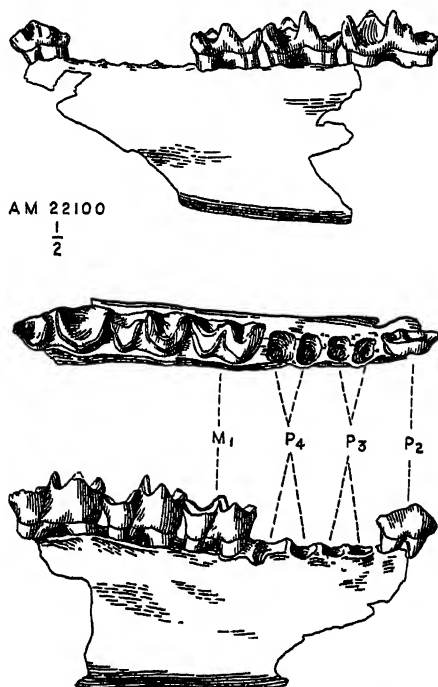


Fig. 2. *Pantolambdaodon inermis*, gen. et sp. nov. Paratype, Amer. Mus. No. 22100. Fragment of the right ramus of the lower jaw: inner, superior and outer views. One-half natural size.

resemblances to the artiodactyls found in the elongate jaw, backwardly sloping weak coronoid process, and possibly spatulate front teeth of our specimens, are merely convergent.

The recent hyracoids need not detain us, while the Egyptian hyracoids figured by C. W. Andrews² have nearly molariform premolars and primitive perissodactyl-like molars.

¹Cope, E. D. 1874. 'On the Homologies and Origin of the Types of Molar Teeth of Mammalia Educabilia.' Journ. Acad. Nat. Sci. Phila., (2) VIII, Part I, Art. III, pp. 71-89, 29 figs.

²Andrews, C. W. 1906. 'Descriptive Catalogue of the Tertiary Vertebrata of The Fayûm, Egypt.' British Museum (N.H.). Pl. vi.

The various families of Condylarthra as revised and figured by Matthew and Granger¹ seem to bring us a step nearer to the possible point of origin of our specimens, since at least the older Condylarthra stand fairly near the foci of the numerous ungulate groups. The bunodont condylarthrs including *Protogonodon* and *Phenacodus* are eliminated from close relationship by the emphasis of the talonid and reduction or absence of the paraconid. In *Ectocion* the crista obliqua, connecting the hypoconid with the base of the metaconid, is inclined anteroposteriorly and the molar pattern is suggestive of the primitive perissodactyl type, but not of the V-shaped configuration of the Mongolian molars; the talonid of P₄ in *Ectocion* is already submolariform and widely different from that of our specimens. The lower molars of meniscotheres have sharply reduplicate metaconids and fairly wide talonids; their P₄ is submolariform. In the Hyopsodontidae, on the other hand, the talonids are distinctly wider than the trigonids and hypoconulids are retained on the molars. These may well be primitive characters for all protoungulates. The premolars also are relatively primitive. In short, it might be rash to affirm that the Mongolian forms were not derived from primitive hyopsodonts, but all the closer resemblances, as we shall see, do not favor such a derivation.

The Dinocerata are excluded by their lophodont molar patterns, to say nothing of other high specializations. In the coryphodonts the lower premolars, on the other hand, approach our Mongolian type and even the molars include two V's. Moreover, definitive coryphodonts were contemporary with our specimens.²

Passing to the Taligrada we note that the smaller Peripitychidae, including *Anisonchus*, are far more primitive, according to accepted standards, than the Mongolian fossils, since *Haploconus*, *Conacodon* and *Anisonchus* have simpler premolars and very primitive bunodont lower molars, with well developed normal talonids. This is true even of *Peripitychus*. Also these forms have more primitive, shorter, stouter jaws with wider, lower ascending rami. In other words, they are all far nearer to the primitive insectivore-creodont central placental type.

When we come to *Pantolambda* and *Titanoides*, however, we find some apparently reliable indications of remote relationship to the Mongolian types, especially in the form of the premolars and molars. In spite of the fact that *Titanoides* is a graviportal form almost as big as

¹Matthew, W. D. 1915. Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 311-328.

Granger, Walter. 1915. Bull. Amer. Mus. Nat. Hist., XXXIV, pp. 329-361.

²Osborn, Henry Fairfield, and Walter Granger. 1932. 'Coryphodonts and Uintatheres from the Mongolian Expedition of 1930.' Amer. Mus. Novitates, No. 552, pp. 1-16.

Coryphodon,¹ it shares the following features with the Mongolian fossils: (1) Dental formula of primitive placental type; (2) P_1 , P_2 compressed; (3) talonid fossa of premolars formed between the posterior ridge connected with the main cone and a transverse metaconid ridge; (4) molar talonids with V-shaped crests; (5) talonid of M_3 narrower than trigonid; (6) M_3 with reduced or no hypoconulids; (7) M_1 , M_2 with no trace of



A.M. 21748

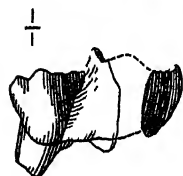


Fig. 3. *Pantolambda inermis*, gen. et sp. nov. Paratype, Amer. Mus. No. 21748. Last right lower molar; inner, superior and outer views. Natural size.

hypoconulid; (8) molars not crowded but slightly spaced; (9) coronoid process inclined backward. *Titanoides* is distinguished from the Mongolian forms by its relatively gigantic size, powerful, more erect incisors and canines; relatively shorter, more massive jaw, etc.

From *Pantolambda* the present form differs in its much more elongate slender jaw, somewhat procumbent front teeth, more hypsodont cheek teeth, compressed premolars; the molars have much larger anterior V's and smaller posterior V's; the ascending ramus slopes backward and is distinctly delicate.

In short, reference to the Amblypoda is indicated by the primitive dental formula, and especially by the peculiar mode of complication of P_2 - P_4 and by the progressive character of the molar trigonids and narrowness of the talonids. That the Mongolian forms represent a new family of Amblypoda seems probable in view of the differences above noted.

Order AMBLYPODA

Family Pantolambdodontidae, fam. nov.

Dental formula: I_3 , C_1 , P_4 , M_3 ; cheek teeth incipiently hypsodont; premolars compressed, two-rooted, P_2 - P_4 with incipient talonid fossa formed between posterior crest of main cusp and sharp metaconid ridge; P_2 - P_4 with well developed trigonid V and incipient talonid V; molars with high trigonid V, and lower, smaller talonid V, trigonid cusps unusually high and pointed; trigonid and talonid basins remarkably deep, a sharp oblique crease on the buccal side running behind the trigonid and crowding the talonid, ending at the top of the talonid root; hypo-

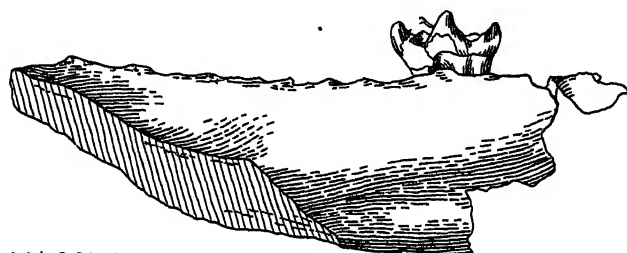
¹Patterson, Bryan. 1934. 'A Contribution to the Osteology of *Titanoides* and the Relationships of the Amblypoda.' Proc. Amer. Phil. Soc., LXXIII, No. 2, pp. 71-101.

conulid absent on M_1 and M_2 , vestigial on M_3 ; lateral incisor spatulate, mandible long and relatively slender, coronoid inclined backward, angular region rounded without distinct process.

Pantolambdodon, gen. nov.

Genotype *P. inermis*

Generic characters not certainly separable from family characters.



AM. 26127

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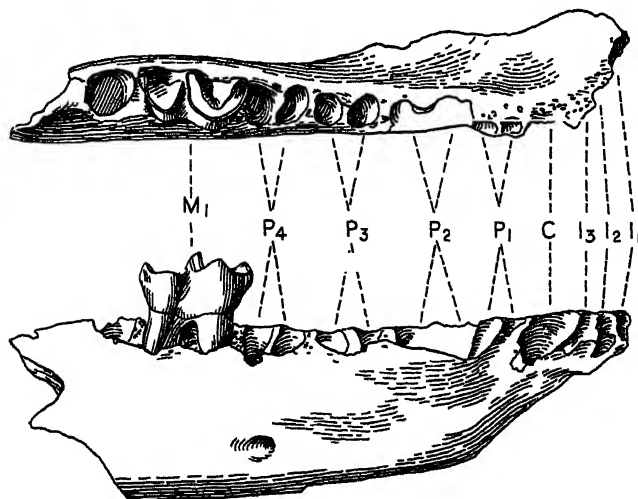


Fig. 4. *Pantolambdodon fortis*, sp., nov. Type, Amer. Mus. No. 26127. Fragment of right ramus of lower jaw: inner, superior and outer views. One-half natural size.

Pantolambdodon inermis, sp. nov.

TYPE.—A. M. No. 21558. Lower jaw, right ramus, with I_3 r. and P_3 - M_2 , alveoli of all other teeth.

PARATYPES.—A. M. No. 22100. Fragment of right ramus of lower jaw with P_2 and M_1 -3. A. M. No. 21748. A last molar of the right side.

LOCALITY.—Eight miles north of Tukhum Lamasery (Chimney Butte). Shara Murun region, Inner Mongolia, 1925.

HORIZON.—Ulan Shireh beds (=Irdin Manha), Upper Eocene.

SPECIFIC CHARACTERS.—Size small, depth of jaw below M_2 , 29–36; M_1 a. p. x tr. (crown), 20×9.5 – 20×11 mm.

Pantolambdodon fortis, sp. nov.

TYPE.—A. M. No. 26127, fragmentary right ramus of lower jaw with M_1 and alveoli of all anterior teeth.

TYPE LOCALITY.—Eight miles north of Tukhum Lamasery (Chimney Butte), Shara Murun region, Inner Mongolia, 1928.

HORIZON.—Ulan Shireh beds (=Irdin Manha), Upper Eocene.

CHARACTERS.—Differing from *P. inermis*, so far as observable, only by its larger size and relatively more massive jaw. See table of measurements.

Measurements of *Pantolambdodon*

	<i>P. inermis</i> No. 21558 Type	<i>P. inermis</i> No. 22100 Paratype	<i>P. inermis</i> No. 21748 Paratype	<i>P. fortis</i> No. 26127 Type
Lower jaw, incisive border to post. border	230			
Depth of jaw below M_2	29	36		48 e.
M_1 to M_2	71 e.	67		
P_1 to P_4	67			
P_2 a.p. \times tr. (crown)		16 $\times 6.5$		
P_3 a.p. \times tr. (crown)	15 $\times 8$			
P_4 a.p. \times tr. (crown)	16 $\times 10$			
M_1 a.p. \times tr. (crown)	20 $\times 9.5$	20 $\times 11$		29 $\times 13$
M_2 a.p. \times tr. (crown)	21.5 $\times 11$	22.7 $\times 11.5$		
M_3 a.p. \times tr. (crown)		26 $\times 11.5$	23 $\times 9$	
M_1 trigonid a.p. \times tr.	11.5 $\times 9$	11 $\times 10$		16 $\times 13.5$
M_1 talonid a.p. \times tr.	8.5 $\times 9$	9 $\times 10$		12.5 $\times 13$
M_2 trigonid a.p. \times tr.	11.5 $\times 9.5$	13 $\times 10.5$		
M_2 talonid a.p. \times tr.	10 $\times 9$	9.5 $\times 9.5$		
M_3 trigonid a.p. \times tr.		15 $\times 11$	12.5 $\times 9.5$	
M_3 talonid a.p. \times tr.		11 $\times 8$	11 $\times 7$	

All measurements in millimeters.

